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THE

ANNUAL JOURNAL

OF THE

ILLINOIS

STATE DENTAL SOCIETY.

v. 20

TRANSACTIONS FOR THE YEAR 1884,

AT

SPRINGFIELD, ILL.

"ARTEM DOCTRINA SANITATEM ARTE."

CHICAGO:
PRINTED BY SKEEN & STUART STATIONERY CO.
1884.

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INDEX TO TRANSACTIONS.

	Page
Annual Meeting, Time and Place of	25
Annual Address, by President E. Noyes	27
Active Members, List of	9
Additions to the By-Laws Offered	22
Appointment of Committee on Dental Science and Literature	23
" Committee on Dental Art and Mechanism	23
" Assistant Secretary	25
Amendment to the By-Laws Proposed	24
Applications of Electrolysis, by Dr. W. B. Ames	102
Corresponding Members Elected during the Meeting	11
Chemistry, by Dr. W. H. Taggart	146
Dento-Embryonal Histology, by Dr. W. X. Sudduth	110
Discussion on Dento-Embryonal Histology	127
Dr. Black	127
Dr. Ingersoll	127
Discussion on Exposed Dental Pulps	41
Dr. J. N. Crouse, Opened by	41-48
Dr. Patrick	43
Dr. A. W. Freeman	45
Dr. Noyes	46
Dr. Eames	43
Dr. Spalding	44
Dr. Black	44-48
Dr. Sitherwood	45
Dr. Newkirk	45
Dr. Ingersoll	45
Dr. Cushing	47
Dr. Brophy	46
Dr. Harlan	48
Discussion on Reflex Pain	54
Dr. Gilmer, Opened by	54
Dr. A. W. Freeman	57
Dr. Black	57
Dr. Patrick	58

PAGE

Discussion on The Origin of Defective Enamel 69
Dr. L. C. Ingersoll, Opened by 69
Dr. Black 77
Dr. Judd 79
Discussion on Inflammation 89
Dr. Crouse 89
Dr. Taft 89
Dr. Black 89
Discussion on Specialists and Specialties 100
Dr. Geo. H. Cushing, Opened by 100
Dr. Taft 101
Discussion on Chemistry 153
Dr. Talbot, Opened by 153
Discussion on Illinois State Dental Society 168
Dr. C. A. Kitchen, Opened by 168
Election of Officers 24
Exposed Dental Pulps, by Dr. S. F. Duncan 33
Honorary and Corresponding Members 11
Invitation to Physicians and Dentists to take part in Discussions . . 15
Invitation to Visit the Old Home of Abraham Lincoln 14
Invitation to His Excellency Governor John H. Hamilton to Visit Society, 23
Inflammation, by Dr. Homer Judd 79
Irregularities in Human Teeth, by Dr. J. J. R. Patrick 127
Illinois State Dental Society: What has it accomplished? by Dr. C. R. E. Koch 156
Members Present at Opening of Meeting 9
Members, List of New 11
Officers, 1883–1884 6
Origin of Defective Enamel, by Dr. W. H. Eames 60
Payment of Secretary and Assistant Secretary's Salaries 22
Preamble and Resolution Offered by Dr. Black 16
Reflex Pain, by Mrs. Dr. Kate C. Moody 49
Roll Call, Showing Number in Attendance 21
Report of Committee concerning International Medical Congress . . 15
" Publication Committee 12–22
" Secretary 12
" Treasurer 13
" Committee on New Appliances and Inventions 20
" Executive Committee on Expenses of the Meeting 25
" " on Accounts of Secretary, Treasurer and Publication Committee 21
" Committee on Recommendations contained in President's Address 16
" Board of Examiners 14–17–18–19
" Committee on Examination of Skulls 21
Resolution Offered by Dr. Black 23
Standing Committees, 1884–85 7–8
Specialists and Specialties, by Dr. G. V. Black 90

PAGE

Sessions—Tuesday Morning 9
" " Afternoon 14
" Wednesday Morning 15
" " " Afternoon 17
" " Evening 18
" Thursday Morning (Clinics) 18
" " Afternoon 19
" " Evening 21
" Friday Morning 21
" " Afternoon 24
Vote of Thanks to the Proprietors of Leland House 26
" " " Railroads 26
" " " Secretary of State 26
" " " Retiring Officers 26
" " to Prof. Seymour, of Normal 23

The Illinois State Dental Society.

Organized July 24, 1865.

OFFICERS, 1884-85.

PRESIDENT,
H. H. TOWNSEND, - - - - - - - Pontiac

VICE-PRESIDENT,
MARK H. PATTEN, - - - - - - - Springfield

SECRETARY,
J. W. WASSALL, - - - - 103 State Street, Chicago

ASSISTANT SECRETARY,
P. J. KESTER, - - - - - - - - Chicago

TREASURER,
C. R. DWIGHT, - - - - - - - - Danville

LIBRARIAN,
J. W. CORMANY, - - - - - - - Mount Carroll

OFFICERS, 1883-84.

PRESIDENT,
EDMUND NOYES, - - - - - - - Chicago

VICE-PRESIDENT,
H. H. TOWNSEND, - - - - - - - Pontiac

SECRETARY,
J. W. WASSALL, - - - - - - - - Chicago

ASSISTANT SECRETARY,
W. H. TAGGART, - - - - - - - Freeport

TREASURER,
J. CAMPBELL, - - - - - - - Bloomington

LIBRARIAN,
W. B. WOODWARD, - - - - - - - Peoria

The next annual meeting will be held at Peoria, on the second Tuesday in May, 1885, continuing four days.

STANDING COMMITTEES, 1884-85.

EXECUTIVE COMMITTEE:

D. J. POLLOCK (Chairman), - - - - - STERLING
C. F. MATTESON, - - - - - - - CHICAGO
W. C. MARTIN, - - - - - - - - PEORIA

SUPERVISOR OF CLINICS:

FRANK H. GARDINER, - - - - - - CHICAGO

COMMITTEE ON PUBLICATION:

J. W. WASSALL, - - - - - - - - CHICAGO
P. J. KESTER, - - - - - - - - CHICAGO

BOARD OF EXAMINERS:

E. D. SWAIN (elected in 1882), - - - - - CHICAGO
T. L. GILMER (elected in 1883), - - - - - QUINCY
GARRETT NEWKIRK (elected in 1884), - - - CHICAGO

STANDING COMMITTEES—Continued.

COMMITTEE ON INFRACTIONS OF THE CODE OF ETHICS:

JAS. G. REID, - - - - - - - Chicago
M. F. HAND, - - - - - - - Joliet
E. DUNCAN, - - - - - - Jacksonville

COMMITTEE ON DENTAL SCIENCE AND LITERATURE:

C. R. E. KOCH (to serve three years), - - - Chicago
HOMER JUDD (to serve two years), - - - Alton
GEO. A. CHRISTMAN (to serve one year), - Chicago

COMMITTEE ON DENTAL ART AND MECHANISM:

JAS. A. SWASEY (to serve three years), - - Chicago
J. FRANK MARRINER (to serve two years), - Ottawa
WM. H. TAGGART (to serve one year), - - Freeport

MINUTES OF TRANSACTIONS

OF THE

TWENTIETH ANNUAL MEETING.

By J. W. WASSALL, M.D., D.D.S.,
SECRETARY.

The Twentieth Annual Meeting of the Illinois State Dental Society was held in the Senate Chamber, at Springfield, on Tuesday, May 13th, 1884, continuing four days.

The first session was called to order at 10:20 A. M., by the President, Dr. Edmund Noyes of Chicago. Rev. Mr. Post of the Congregational Church, invoked the divine blessing on the proceedings of the Society.

The minutes of the last annual meeting, having been printed and distributed, were not read.

The list of active members is as follows; those in *italics* having been present some time during the meeting, and those marked with an asterisk (*) having sent dues:

Allen, E. H., Freeport.
*Allport, W. W., Chicago.
Baker, D. B., Quincy.
Baldwin, C. V., Danville.
Beckwith, T. W., Sterling.
Black, G. V., Jacksonville.
Blythe, J. M., Decatur.
Brophy, T. W., Chicago.
*Brown, A. E., Chicago.
Call, E. B., Peoria.
Cameron, Geo. M., Carrollton.
Campbell, J., Bloomington.
Carpenter, Geo. T., Chicago.
Christianer, F., Abingdon.
Christman, Geo. A., Chicago.
Clark, A. B., Chicago.
Collins, J. W., Lincoln.
Cormany, J. W., Mount Carroll.

Creswell, J. J., Galena.
Crouse, J. N., Chicago.
Cushing, Geo. H., Chicago.
David, E. B., Aledo.
Davis, J. A. W., Galesburg.
Davis, K. B., Springfield.
Dean, W. W., Lacon.
Dorn, C. P., Naperville.
Downing, J. M., Macomb.
Duncan, E., Jacksonville.
Duncan, S. F., Wilmington.
Dwight, C. R., Danville.
Fisher, J. W., Bloomington.
Fitch, Henry H., Pekin.
Fraenkel, Wilhelm, Chicago.
Freeman, A. W., Chicago.
Freeman, D. B., Chicago.
Gardiner, Frank H., Chicago.
Gill, Henry C., Rockford.
Gilmer, T. L., Quincy.
Green, E. J., Peoria.
Guffin, E. L., Chicago.
Hanaford, M. L., Rockford.
Hand, M. F., Joliet.
Harlan, A. W., Chicago.
Harrington, G. H., Delavan.
Harrison, B. T., Gibson City.
Haskell, L. P., Chicago.
Henry, Charles, Jacksonville.
Honsinger, E., Chicago.
Howard, G. O., Waukegan.
Hurtt, J. M., Mount Vernon.
Hyde, J. H. Lewiston.
Johnston, Wm. A., Peoria.
Kester, P. J., Chicago.
King, E. F., Macomb.
Kitchen, C. A., Rockford.
Koch, C. R. E., Chicago.
Lane, Wm. J., Decatur.
Lawrence, R. Neal, Lincoln.
Lionberger, J. M., Dallas City.
McCoy, T. H., Pana.
Magill, W. T., Rock Island.
Marriner, J. Frank, Ottawa.
Marshall, John S., Chicago.
Martin, W. C., Peoria.
Matteson, A. E., Chicago.
Matteson, C. F., Chicago.
Miles, Geo. S., Jerseyville.
Moody, J. D., Mendota.
Moody, Mrs. Kate C., Mendota.
Murphy, J. D., Bushnell.
Nelson, Nels., Chicago.
Newkirk, Garrett, Chicago.
Noyes, Edmund, Chicago.
Ormsbee, W. W., Geneva.
*Ottofy, Louis, Ottofy, Dak. T.
Patrick, J. J. R., Belleville.
Patten, M. H., Springfield.
Peck, J. W., Canton.
Phelps, J. R., Chicago.
Phillips, L. T., Nashville.
Pitwood, E., Kankakee.
Pollock, D. J., Sterling.
Prichett, T. W., Whitehall.
Priestman, Wm. H., Pontiac.
Pruyne, C. P., Chicago.
Reid, Jas. G., Chicago.
Robbins, E. M., Carthage.
Rohland, C. B., Alton.
Salter, G. B., Joliet.
Sawhill, F. H., Clinton.
Schadle, A. C., Warren.
Sitherwood, Geo. D., Bloomington.
Smith, H. J., Quincy.
Stephens, J. W., Dixon.
Stevens, W. A., Chicago.
Stone, E. C., Galesburg.
Sturgiss, S. M., Quincy.
Sudduth, Will. X., Bloomington.
Sunderland, D. E., Freeport.
Swain, E. D., Chicago.
Swasey, J. A., Chicago.
Taggart, W. H., Freeport.
Talbot, E. S., Chicago.
*Taylor, C. R., Streator.
Thompson, J. F., Chicago.
Tibbets, C. J., Quincy.
Townsend, H. H., Pontiac.
Verbeck, S. H., Lena.
Waltz, A. S., Decatur.
Waltz, Geo. W., Decatur.
Wassall, J. W., Chicago.
Wheeler, Thos. B., Chicago.
Widenham, J. C., Jacksonville.
Willson, O., Aurora.
Wonderly, Thos. G., Galena.
Woodward, W. B., Peoria.

During the four days of the meeting the following named new members were elected and qualified:

Ames, W. B., Chicago.
Burrews, A. E., Walnut.
Fishburn, J. M., El Paso.
Goebel, Robert, Lincoln.
Gregory, C. L., Chicago.
McIntosh, F. H., Bloomington.
Mace, R. H., Belleville.

Dr. Homer Judd, late of St. Louis, and now of Alton, was transferred from corresponding to active membership.

Dr. F. W. Dean of Des Moines, and Dr. C. W. Stutenroth of Watertown, D. T., were elected corresponding members of the Society.

The following is a list of the honorary and corresponding members with their residences, so far as known to the Secretary. Those whose names are in italics were present at the meeting:

G. W. Keeley, Oxford, Ohio.
W. H. Eames, St. Louis, Mo.
Edgar Parks, St. Louis, Mo.
Isaiah Forbes, St. Louis, Mo.
H. J. McKellops, St. Louis, Mo.
R. J. Poore, Cincinnati, Ohio.
H. S. Chase, St. Louis, Mo.
W. C. Barrett, Buffalo, N. Y.
F. A. Brewer, San Francisco, Cal.
W. N. Morrison, St. Louis, Mo.
W. O. Kulp, Davenport, Iowa.
I. P. Wilson, Burlington, Iowa.
C. C. Chittenden, Madison, Wis.
R. S. Rathbun, Clinton, Iowa.
L. C. Ingersoll, Keokuk, Iowa.
J. Taft, Cincinnati, Ohio.
C. R. Butler, Cleveland, Ohio.
H. N. Lewis, Quincy, Ill.
C. S. Smith, Lancaster, Wis.
J. Hardtner, Springfield, Ill.
C. W. Spalding, St. Louis, Mo.
A. H. Fuller, St. Louis, Mo.
Geo. A. Bronson, St. Louis, Mo.
J. G. Templeton, Pittsburg, Pa.
Gale French, Pittsburg, Pa.
Jno. B. Morrison, Indianapolis, Ind.
George Watt, Xenia, Ohio.
Thomas W. Reed, Macon, Mo.
J. W. Reed, Mexico, Mo.
F. W. Dean, Des Moines, Iowa.
C. W. Stutenroth, Watertown, D. T.

Dr. M. H. Patten, in the capacity of a citizen, welcomed the Society to Springfield, and as Chairman of the Executive Committee reported the printed programme previously distributed as the order of exercises for the meeting.

The committee also recommended that two members of the Executive Committee for the twenty-first annual meeting be elected early in this meeting.

Dr. Brophy moved the adoption of the above report, excepting that part of the report recommending the election of two members of the next Executive Committee. Carried.

The Committee on Publication reported as follows:

Mr. President and Gentlemen of the Illinois State Dental Society:

Your Committee have caused to be published and distributed 450 copies of the Transactions for the year 1883, except a few copies which are still on hand.

Appreciating the utility of Dr. Black's chart showing the lines of contemporaneous calcification of the teeth, the Committee have had 500 printed in card form, to hang near the operator's chair for easy reference. They are for sale by dealers and the Secretary.

The bill of expenses is as follows:

DR.

To printing and binding, in paper and cloth, 450 copies, as per bill of Ransom & Randolph	$163 50
To engraving cuts, as per bills of Photo Engraving Co., of New York	108 40
To printing 500 of Dr. Black's charts	6 50
To Postage, Express, Cartage and Freight charges on Transactions, Correspondence, Copy, Proofs, Stationery, etc	45 10
	$323 50

CR.

Received from sale of Transactions	$4 00	
" " " Dr. Black's charts	3 50	7 50
		$316 00

As regards the printed forms for tabulating the condition of the teeth of school children, your Committee desire that further time may be granted them.

REPORTS OF OFFICERS.

SECRETARY'S REPORT.

Mr. President and Gentlemen of the Illinois State Dental Society:

Your Secretary offers the following annual report:

The number of active members at date of the last report was	106
The number of new members received in 1883	17
Making a total of	123

There are now lost, by resignation, one,
Dr. W. P. Richards;
By non-payment of dues:
Drs. R. H. Antes, Geneseo,
J. H. Kennicott, Chicago,
W. H. Mills, Freeport,
O. H. Smith, Sycamore,
E. H. Stewart, Joliet..... 6

Leaving a membership at this time of..... 117

Drs. Geo. Watt of Xenia, Ohio, Thos. W. Reed of Macon, Mo., and J. W. Reed of Mexico, Mo., were made corresponding members at the meeting in 1883; and the present number of honorary and corresponding members, so far as known to the Secretary, is thirty.

The receipts for dues and initiation fees were $500, for which amount the Treasurer's receipts are herewith submitted.

Delinquent notices have been sent as usual to the members in arrears, twice during the year, and to each of those who are now dropped for non-payment of dues a personal letter has very recently been written, drawing attention to Section 1 of Article IV of the By-Laws—except in the case of Dr. Kennicott, who informed me personally that it was his desire to be dropped from membership.

Respectfully submitted,

J. W. WASSALL, *Secretary.*

TREASURER'S REPORT.

Mr. President and Gentlemen of the Illinois State Dental Society:

Your Treasurer offers the following annual report:

RECEIPTS.

To balance received from last Treasurer.....	$209 08	
To amount received from Secretary, August 16, 1883.....	428 00	
" " " " " May 13, 1884.....	72 00	
		$709 08

DISBURSEMENTS.

By cash as per Voucher, No. 50.....	$ 25 00	
" " " " " 49.....	100 00	
" " " " " 51.....	32 50	
" " " " " 52.....	80 00	
" " " " " 53.....	56 00	
" " " " " 54.....	50 00	
" " " " " 55.....	170 00	
" " " " " 56.....	45 10	
Exchange.....	75	
Total Disbursements.....	$559 35	$559 35
Balance in Treasury.....		$149 73

J. CAMPBELL, *Treasurer.*

Dr Brophy moved. that during the order of miscellaneous business at the Wednesday morning session, there be elected two members of the Executive Committee for the twenty-first annual meeting, their power not to supersede that of the present Executive Committee. The motion prevailed.

The Chair appointed Dr. J. Frank Marriner of Ottawa, to act on the Executive Committee in place of Dr. C. R. Taylor, absent.

The Board of Examiners reported, recommending W. B. Ames. D.D.S. of Chicago. and C. L. Gregory, D.D.S. also of Chicago, as candidates for membership.

Dr. Koch moved that both candidates be voted for at one ballot, and if any negative votes be cast then that each name should be voted for separately.

The candidates were unanimously elected.

The Vice President, Dr. H. H. Townsend of Pontiac, took the chair, and the President read the annual address.

Dr. Koch moved, that that part of the President's address suggesting the appointment of Standing Committees, be referred to a Special Committee of three, consisting of Drs. Black, Cushing and Kitchen, for deliberation, and that this committee report at the present meeting of the Society.

Dr. Brophy moved that all papers which are to be read at this meeting be forthwith placed in charge of the Secretary, to prevent delay in carrying out the programme. Carried.

The Society adjourned till 2:30 P. M.

TUESDAY AFTERNOON SESSION.

The Society was called to order at 2:30 P. M. by President Noyes. The minutes of the morning session were read and approved.

There was read by the Secretary an invitation to the Society from Mr. O. H. Oldroyd, to visit the old home of Abraham Lincoln. The Society agreed to go in a body, at 5 P. M., on Wednesday.

Dr. Harlan, as Chairman of the Committee to obtain information concerning a Section on Dentistry in the International Medical Congress, reported that he had written a letter of inquiry to Charles S. Tomes, of London, early in the year, the reply to which, and a lack of any references to a dental section in the Medical and Dental Journals, led him to judge that our specialty would not be represented in the Congress.

On motion the report was accepted and the Committee discharged.

Dr. S. F. Duncan of Wilmington, read his paper, entitled "Exposed Dental Pulps, and their Treatment."

The discussion of the subject was opened by Dr. J. N. Crouse, who was followed by Drs. Patrick, A. W. Freeman, Townsend, Dorn, Nelson, Noyes, Eames, Spalding, Black, Sitherwood, Newkirk, Ingersoll, Cushing, Brophy and Harlan, and then passed.

On motion of Dr. Crouse, physicians who might be present, and dentists from other States, were invited to participate in the discussions.

The Society adjourned to meet on Wednesday at 9 A. M.

SECOND DAY—WEDNESDAY MORNING SESSION.

The Society was called to order at 9:25 A. M., by President Noyes.

The minutes of the preceding session were read and approved.

President Noyes, for the Publication Committee, explained the delay in distributing the Transactions of the last annual meeting.

According to the resolutions adopted, as per recommendation of the Executive Committee, two members of the Executive Committee for the twenty-first meeting were balloted for.

Dr. Koch moved that in all elections during this annual meeting, the three persons having the largest number of votes at the informal ballot shall be the candidates, and after each formal ballot the candidates having the least number of votes shall be dropped. Carried.

The ballot for two members of the Executive Committee resulted in the election of Dr. D. J. Pollock of Sterling (Chairman), and Dr. C. F. Matteson of Chicago.

Dr. Black, Chairman, reported the following:

To the President and Members of the Illinois State Dental Society:

Your Committee, appointed to consider and report on the recommendations contained in the President's address, beg leave to offer the following, and recommend its adoption:

Resolved, That the following Committees be created:

First, A Committee consisting of three members, on Dental Science and Literature, whose duty it shall be to report annually, on the first day of the annual meeting, on the progress of science and literature as appertaining to dentistry, and give a resumé of all that may be new and important.

Second, A Committee of Three, on Dental Art and Invention, whose duty shall be, to report on [the first day of each annual meeting] the advance made during the year in the arts and inventions appertaining to dentistry.

The members of these Committees shall be selected with reference to their special fitness for these duties, and be appointed by the President.

The term of office shall be for three years, after the first appointment, which shall be for one, two and three years.

G. V. BLACK,
GEO. H. CUSHING,
C. A. KITCHEN,
Committee.

The report was adopted, and the Chair stated that the Committee would be appointed later in the meeting.

Dr. Black offered the following preamble and resolution:

WHEREAS, The manner and time of the publication of the Transactions of this Society have not always been entirely satisfactory; and,

WHEREAS, There seems to be a need of a truly Scientific Dental Journal; therefore,

Resolved, That a Committee of Three be appointed by the Chair, who shall carefully consider the advisability of establishing a Monthly Journal of not less than sixty pages, at a price of not less than ($5.00) five dollars per year, which shall be under the direction of this Society and the Chicago Dental Society, or one of them individually, and shall journalize the proceedings of each of these—and call out the best work of the best men in the profession outside of these organizations.

Resolved, That this Committee shall report at the next annual meeting of this Society.

Resolved, That the Chicago Dental Society be requested to appoint a Committee to act in conjunction with the Committee of this Society.

The resolution was discussed by Drs. Sturgiss and Crouse, and on motion of Dr. Koch was adopted.

Mrs. Dr. Kate C. Moody of Mendota, read a paper, entitled "Reflex Pain."

The discussion was opened by Dr. Gilmer of Quincy, who was followed by Drs. A. W. Freeman, Black, Reid, Sudduth, W. H. Conrad of St. Louis, Patrick, Townsend, Sitherwood and Noyes, and the subject was passed.

Dr. W. H. Eames of St. Louis, read a paper entitled, "Origin of the Defective Tooth Structure, known as Pitted, Furrowed, or Cribriform Enamel."

On motion the discussion of this subject was laid over until the afternoon session.

Adjourned to meet at 2:30 P. M.

WEDNESDAY AFTERNOON SESSION.

The Society was called to order by the President at 2:45 P. M.

The Board of Examiners recommended for active membership Robert Goebel, D.D.S. of Lincoln, R. H. Mace, D.D.S. of Belleville, A. E. Burrews of Walnut; and for corresponding membership, Dr. F. W. Dean of Des Moines, Iowa.

In the matter of the election of the active members, Dr. Koch moved that the three candidates be voted for at one ballot, and in case of a negative vote they be voted for separately. Carried.

They were unanimously elected.

Dr. Dean was elected a corresponding member by a *viva voce* vote.

On motion of Dr. Brophy, Drs. Stone, Koch and Woodward were made a Committee on New Appliances and Inventions, with instructions to report to the Society during the order of miscellaneous business, Thursday afternoon.

The discussion of Dr. Eames' paper was opened by Dr. L. C. Ingersoll, followed by Drs. Black, Sudduth, Crouse and Judd, and the subject was passed.

Dr. Homer Judd read a paper entitled, "Inflammation."

The hour having arrived for visiting the old home of Abraham Lincoln, the discussion was postponed, and the Society adjourned till 8 P. M.

WEDNESDAY EVENING SESSION.

The President called the Society to order at 8:15 P. M.

The minutes of the preceding session were read and approved.

The Secretary read an announcement of the meeting of the National Dental Association of the United States of America.

The Chair presented a communication, asking the Society to appoint delegates to meet representatives from other State Societies for the formation of a National Dental Association.

On motion the call was laid on the table indefinitely.

The Board of Examiners recommended for active membership Dr. F. H. McIntosh of Bloomington.

The candidate was unanimously elected.

The special order of the evening was then taken up, viz.:

The reading of an essay, by Will. X. Sudduth, entitled "Dento-Embryonal Histology."

The subject was discussed by Drs. Black and Ingersoll, and passed.

The regular order was then recurred to, viz.: The discussion of Dr. Judd's paper on "Inflammation." Drs. Crouse, J. Taft and Black spoke on the subject, and it was passed.

The following morning having been set aside for clinics, the Society adjourned to meet Thursday at 2:30 P. M.

THIRD DAY—THURSDAY MORNING—(CLINICS.)

The following named gentlemen operated:

Edgar D. Swain, Chicago. (Gold Crown.)
H. H. Townsend, Pontiac. (Root Filling.)
W. N. Conrad, St. Louis. (Porcelain Crown.)
E. Honsinger, Chicago. (Filling with Crystal Gold.)

W. T. Magill, Rock Island. (Gold Filling.)

J. A. Swasey, Chicago. (Filling with Gold and Tin.)

J. G. Reid, Chicago. (Filling Roots with Gutta Percha.)

T. W. Brophy, Chicago. (Devitalized a Pulp with Red-Hot Platinum Wire.)

Dr. How, Philadelphia. (Crown.)

THURSDAY AFTERNOON SESSION.

The President called the Society to order at 2:40 P. M.

The minutes of the preceding session were read and approved.

The Committee on New Appliances and Inventions were granted further time to report.

The Board of Examiners recommended for active membership, Dr. J. A. Bowman of Shelbyville, and Homer Judd, M. D. of Alton.

The Chair ruled that both candidates would be balloted for together, and in case of no negative votes they would be declared elected.

The candidates were unanimously elected.

President Noyes stated that Dr. Judd, as a resident of St. Louis, had long been a corresponding member, but now having moved into the State this action was taken in order to retain his membership.

Dr. Black said that Dr. Judd, as a corresponding member, had been an earnest and valuable worker in the Society since its organization, and moved, as a special mark of honor to Dr. Judd, that his dues to this Society be remitted for life.

Dr. Cushing, in seconding the motion, said, that to Dr. Judd, more than to any one man, the Society was dependent for its progress and its success.

Dr. Brophy moved that all properly authenticated bills on account of this meeting be paid by the Executive Committee. Carried.

On motion of Dr. Stevens, Dr. Koch's paper was made the special order under the head of essays and discussions on Friday morning.

The Chair announced the appointment of the committee to consider the advisability of establishing a Monthly Dental Journal as follows: Drs. G. V. Black, J. D. Moody and T. W. Brophy.

The special order was then called, and Dr. W. H. Taggart of Freeport, read his essay, entitled "Chemistry."

The discussion was opened by Dr. Talbot, followed by Drs. Black and Cushing. The subject was passed.

Dr. Patrick read his paper, entitled "A Stray Leaf from the First Chapter on Dental Education."

Dr. G. V. Black of Jacksonville, read his paper, entitled "Specialists and Specialties."

The discussion of the subject was postponed.

Dr. Koch read the report of the Committee on New Appliances and Inventions, as follows:

Your Committee, appointed to examine New Appliances, beg leave to submit the following report:

Various new inventions and appliances in mechanical and operative dentistry have been submitted for our inspection, and we present the following as worthy of notice:

In the operative department we call your attention to the S. S. White No. 7 hand piece for the dental engine; to Bonwill's universal-joint hand piece; to Hodges' right angle universal-chuck hand piece; to a fine syringe point of Dr. Call's; to White's capillary dropper; to a gas annealing lamp, introduced by the White Manufacturing Company; to Howe's screw driver; to a method of waxing tape, suggested by Dr. Shepherd, of Boston, for the purpose of separating teeth; and a single-jointed clamp has also been shown us by J. W. Collins.

We also desire to call your attention to Dr. Templeton's method of making articulating casts for full upper and under sets of teeth, which he will explain personally, if permitted.

In the mechanical department we call your attention to Fletcher's new annealing and soldering lamp; Dr. Swasey's method of making corundum and rubber disks, and die for same; to a new disk mandrel and mounter, for mounting paper disks; to Collins' gas blow-pipe; to Collins' paper disk cutter; and to a set of three spatulas or carvers for plastic work.

E. C. STONE,
C. R. E. KOCH,
W. B. WOODWARD,
Committee.

Dr. McKellops of St. Louis, commended the Bonwill dental engine with universal joint, and described the method of preparing and using waxed tape for separating teeth.

Dr. J. G. Templeton of Pittsburg, explained his method of articulating full sets of artificial teeth, which obviates the necessity for grinding off the cusps, when first inserted.

Dr. J. A. Swasey of Chicago, exhibited a contrivance, and explained his method of making and mounting corundum polishing points by means of it.

Adjourned to meet at 7 o'clock P. M.

THURSDAY EVENING SESSION.

The Society was called to order by the President at 8 P. M.

The minutes of the preceding session were read, corrected and approved.

On motion of Dr. Koch, the Secretary was directed to transmit to Mr. Oldroyd the thanks of the Society and assurance of their individual appreciation of the privilege of visiting the old home of Abraham Lincoln.

The Executive Committee reported the accounts of the Publication Committee, Secretary and Treasurer correct.

On motion, their report was accepted.

Roll calls showed that eighty-six active members and twelve corresponding and honorary members had been present during the meeting.

The special order for the evening was then called.

Dr. Will. X. Sudduth of Bloomington, assisted by Prof. Seymour, gave a lantern exhibition of microscopical drawings and slides, illustrating the development of the jaws and teeth.

The Society adjourned to meet Friday morning at 9 o'clock.

FOURTH DAY—FRIDAY MORNING SESSION.

The Society was called to order by the President at 9:30 A. M.

The minutes of the preceding session were read and approved.

Dr. Crouse, for the Committee on Examination of Skulls in the Larger Museums, recommended that three thousand charts,

similar to the one prepared for this purpose by Dr. Patrick, be printed under the supervision of the Committee on Publication, to be distributed to such members as may desire them.

On motion, the report was accepted, the committee continued, and the recommendation ordered executed.

The Board of Examiners recommended for active membership, Dr. F. M. Fishburn of El Paso, and for corresponding membership, Dr. C. W. Stutenroth of Watertown, D. T., who were unanimously elected.

On motion of Dr. Crouse, the President and Secretary were instructed to furnish certificates to such members as desire to attend the American Dental Association.

Casts of a case of irregularity, showing the deformity and its subsequent correction, were exhibited to the Society by Dr. J. Campbell of Bloomington.

The Publication Committee made the following supplementary report, which was accepted:

Your Committee, in the matter of publishing and distributing blanks for the purpose of tabulating the conditions of children's teeth, have had plans under careful consideration during the past year, and at this meeting have counseled with some members who are peculiarly interested in this subject, and have prepared a form which will enable those who can be interested in the work to gather valuable statistics.

On the recommendation of the Executive Committee, one hundred dollars was ordered to be paid to the Secretary, and twenty-five dollars to the Assistant Secretary.

President Noyes offered the following additions to the By-Laws:

First, The Committee on Publication shall consist of the Secretary and Assistant Secretary, who shall have power to cut down, amend or leave out, in preparing the Transactions for publication.

Second, That the resolution adopted at the meeting in 1881, concerning honorary and corresponding members, be incorporated into the By-Laws.

Third, That the resolution creating the office of Assistant Secretary be incorporated into the By-Laws.

Dr. Black offered the following resolution, which was adopted:

Resolved, That a Supervisor of Clinics shall be appointed by the President, to serve one year. It shall be the duty of the Supervisor of Clinics to make all arrangments for the holding of clinics for the several meetings of this Society and have charge of the rooms, fixtures, etc., and shall determine who shall or shall not operate, what operations shall be performed, etc. Shall keep a record of all operations in a book provided for that purpose, and make a report to the Society annually, at the first session after the holding of the clinics of the year, and shall, as far as possible, report the results of operations of previous years, with any observations that may be of interest or benefit to the progress of dental art. The Supervisor may appoint one or more deputies, as may be required.

Dr. Cushing read a communication from the Dentist's Scientific and Benevolent Association, which he was pleased to recommend as a good life insurance association.

The Secretary was directed to transmit a vote of thanks to Prof. Seymour of Normal, for his assistance in Dr. Sudduth's lantern exhibition.

The President announced the appointment of the following Standing Committees:

On Dental Science and Literature—Dr. C. R. E. Koch to serve for three years, Dr. Homer Judd to serve for two years, Dr. Geo. A. Christman to serve for one year.

On Dental Art and Mechanism—Dr. Jas. A. Swasey to serve for three years, Dr. J. Frank Marriner to serve for two years, Dr. W. H. Taggart to serve for one year.

On motion of Dr. Frank H. Gardiner, the special order of the morning was waived, and the discussion on "Dental Education" was called and opened by Dr. Cushing, who was followed by Prof. Taft. The subject was passed.

Dr. Patten moved that all papers be read and the persons appointed to open the discussions be heard before other members be allowed to discuss. Carried.

Dr. W. B. Ames of Chicago, read his paper, entitled "Some Applications of Electrolysis in Dentistry."

On motion, Drs. Black and Kitchen were appointed a Committee to invite his Excellency Governor John H. Hamilton to visit the Society. He was presented to the Society by President Noyes, and made a short speech, after which, on motion, a recess of five minutes was taken to shake hands with the Governor.

The meeting was called to order at 11:35 A. M., and Dr. J. J. R. Patrick of Belleville, read a paper, entitled "Irregularities," which was illustrated with models, drawings and specimens.

The Society adjourned to meet at 2:30 P. M.

FRIDAY AFTERNOON SESSION.

The Society was called to order by the President at 2:45 P. M.

The minutes of the preceding session were read and approved.

Dr. A. W. Harlan offered the following amendment to the By-Laws:

At the next election the members of the Executive Committee shall be chosen to serve for one, two and three years respectively, and thereafter one member shall be elected annually to serve three years—the senior member of the Committee to be its Chairman.

Dr. Geo. D. Sitherwood of Bloomington, offered the following amendment to the By-Laws:

First, That any practitioner of dentistry in good standing within the State, who shall be recommended by three members of this Society, shall upon such recommendation, and the unanimous consent of the Society, be known as student or probationary member—such membership to continue for one or two years, at the option of such member.

Second, That such student or probationary member may at any session of this Society, upon the recommendation of the Board of Examiners, be voted to full membership.

Dr. C. R. E. Koch of Chicago, read his essay, entitled "Illinois State Dental Society—What has it Accomplished?"

The discussion was opened by Dr. C. A. Kitchen of Rockford, who was followed by Dr. J. N. Crouse.

ELECTION.

The election of officers resulted as follows:

President—H. H. Townsend of Pontiac.
Vice-President—Mark H. Patten of Springfield.
Secretary—J. W. Wassall of Chicago.
Treasurer—C. R. Dwight of Danville.
Librarian—J. W. Cormany of Mount Carroll.

On motion of Dr. Cormany, the Secretary was authorized to buy a desk or box suitable for keeping the records, papers, etc., appertaining to the secretaryship.

Peoria was chosen, on the first ballot without a dissenting vote, as the place for holding the next annual meeting.

For resident member of the Executive Committee, Dr. W. C. Martin of Peoria, was elected.

The Chair nominated Dr. J. W. Cormany of Mount Carroll, to fill the vacancy in the Board of Examiners, who declined.

The Chair then nominated, and the Society elected Dr. Garrett Newkirk of Chicago, to be a member of the Board of Examiners.

The Secretary appointed, and the Society approved Dr. P. J. Kester of Chicago, for Assistant Secretary.

The newly elected officers were installed.

Ex-President Noyes, in leaving the chair, said:

I wish to thank you for the very great kindness and unexpectedly complete and cordial support which have been accorded me during this meeting.

I appreciate, more fully than ever before, the difficulty of administering such an office with either wisdom or efficiency. It would be far easier, if it were possible for the President to know all the members well, and to estimate fairly the character and abilities of each.

That I have made many errors and mistakes of judgment is too apparent to need confession. Your cordial support, notwithstanding, I acknowledge with sincere gratitude. That I have acted without conscious bias from personal or ambitious motives I beg you to believe.

I am proud of the Illinois State Dental Society. Your strong good sense, your earnest attention to matters of real importance, and the rapidly increasing number of studious men in your membership afford the brightest promise of honors and usefulness awaiting your future.

The Executive Committee reported the expenses of the meeting, $50.50, and all bills paid.

Dr. K. B. Davis moved a vote of thanks to the proprietors of the Leland House, for the use of the Ladies' Ordinary for clinics, and other favors. Carried.

The President was appointed to deliver the next annual address.

Dr. Harlan moved that the Committee on Publication have discretion to cut down, amend or leave out in preparing the Transactions for publication, and as to the number of copies to be printed. Carried.

A vote of thanks was moved to the railroads, for their reductions in rates to the members in attendance. Carried.

A vote of thanks was moved to the Secretary of State, for the use of the Senate chamber in holding the meeting. Carried.

President Townsend appointed:

For Supervisor of Clinics—Dr. Frank H. Gardiner of Chicago.

For Committee on Infractions of the Code of Ethics—Dr. Jas. G. Reid of Chicago, Dr. M. F. Hand of Joliet, and Dr. E. Duncan of Jacksonville.

Dr. Cushing moved a vote of thanks to the retiring officers. Carried.

Dr. Gardiner appointed as Assistant Supervisors of Clinics, Dr. W. B. Ames of Chicago, and Dr. W. B. Woodward of Peoria.

The minutes of this session were read, corrected and approved.

The Society adjourned to meet at Peoria on the second Tuesday in May, 1885.

ADDRESSES, ESSAYS AND DISCUSSIONS.

ANNUAL ADDRESS,

BY THE PRESIDENT, DR. EDMUND NOYES OF CHICAGO.

GENTLEMEN OF THE ILLINOIS STATE DENTAL SOCIETY:

You have given me the honor which carries with it the pleasant duty to bid you welcome to this the twentieth annual meeting of our Society, and to furnish the introduction to the good things that will claim your attention for the next four days. I am not aware that the year has been a specially eventful one in our annals; nor are there any matters concerning the organization or the working methods and policy of the Society which appear to require any very radical changes or modifications. These I believe to be essentially correct in theory, and unusually well administered in practice.

It is now seven years since the changes were made in the Constitution and By-Laws which created the Board of Examiners, and indicated the intention on the part of the Society to ascertain, with some care and thoroughness, the respectability and qualifications of candidates for membership. It is my belief that the best interests of the Society have been greatly promoted by this policy, and probably very few would now desire to return to the old slipshod and free and easy way of admitting members. It is desirable, rather, to raise the standard a *little* higher, and make our examinations correspond as closely as possible with those of the State Board of Examiners. To that end it is proper that the friendliest relations should subsist between the two Boards, and the freest possible communication and good understanding.

I congratulate you upon the spirit of harmony and friendliness which has always characterized our membership, and the large proportionate number who have, during the successive years of our history, become mutually well acquainted. The rapid increase of our numbers may make it somewhat more difficult, in the future, to maintain our wonted harmony and good fellowship of the entire number—a little more patience and self restraint, a little larger charity and good will may be required than heretofore. (I doubt not they will be forthcoming when needed.) The greater the proportion of our membership that can be induced to attend the meetings with regularity, from year to year, and especially the greater the number who will make the effort necessary to contribute something to our proceedings, the more harmonious and useful we are likely to become.

Under our present management very few men can get admitted to our Society who have not the qualifications necessary to make some contributions to our proceedings; and *every one* of our members should feel himself under obligation to do so, as occasion may require, and should endeavor to *make* occasion at reasonably frequent intervals. This is not too much to ask, in view of the very wide range of subjects which are proper to be brought before us, and the great number of *objects* that might be prepared for our inspection.

One motive you all have in coming here is the hope of learning something new, and the first honors may rightly be given to communications containing something new. I do not mean things new to some of us who did not happen to know them before, but new to the art or science of dentistry: in other words, papers giving some account of original investigations or experiments. We are unusually fortunate in the number of our members who are able and willing to spend their time in original work, and who, from year to year, bring us the results of their labors to be made public in the meetings of this Society.

It is scarcely second in importance, and is often quite as useful, to pass in review in these meetings the things we knew before, and, especially, to find out if others know them in the same way that we do. It often wonderfully fortifies a man's confidence in himself to find that many other good men are performing operations, or conducting their practice upon the same methods and

according to the same principles as himself. Almost any man of ordinary intelligence, and having had a reasonably good professional education, is quite competent to choose some subject, and in the course of a year to gather together the necessary books or periodicals and read them, or to make the needful observations and experiments, and then to write a paper that shall present a fairly comprehensive and accurate statement of knowledge, opinions or practice relating to that subject; and there are a hundred different matters concerning which we should all be glad to brighten our knowledge or freshen our recollection in that way, at very frequent intervals.

It would be equally proper and useful to attempt a thorough and exhaustive study and discussion of some subject, or part thereof, concerning which an ordinary professional education confers only a general and elementary knowledge of the essential parts. I will venture to enumerate a very few matters that seem to me worthy to be prepared for some of our future meetings, in the hope that some seeds may chance to fall upon good ground and prove fruitful; or, if the *seeds* should not be well chosen, that at least some *soil* may be stirred up so as to catch and nourish other seeds which are constantly flying about, but often perish because the ground on which they fall is hard and sterile. The men who do original work need little suggestion or stimulus; they are eager students, and toil and delve for the love of knowledge. It would, however, be a useful service for others to follow and duplicate their experiments. For instance, if there were half a dozen, instead of one or two of our members, who were making microscopic studies and preparing specimens to discover and illustrate all the steps of tooth development, the confirmation and corrections of numerous independent observers would be valuable, and the history would sooner be made complete and accurate. It is true, however, that these things require great patience and much time, and but few can undertake them if they would.

The investigation of the relations of parasites to fermentation, and the particular kinds to be found at work in the mouth or in carious teeth, and a determination of the nature and effects of their digestive solvents and waste products, must be undertaken by somebody, and appears to be one of the promising fields for future cultivation.

If a considerable number of men were to make careful saliva tests, with reference to acidity or alkalinity; the preponderance of saliva or mucus in the mixed fluid of the mouth; the relation of alkalinity or acidity to the presence or absence of tartar and caries, and the determination of whether, in alkaline mouths, the contents of carious cavities or the carious dentine itself were acid or not; the determination of these questions of fact, by numerous and careful experiments (if they showed any uniformity in relations or results) could not fail to be interesting, and might prove useful.

The methods of manufacture of gold foil; the different forms and conditions in which it may be used; the theories and methods of manipulation most suitable for the different forms; the places for which each is most appropriate; the various combinations or juxtapositions of gold with other metals or materials, which are justifiable or useful, etc., would furnish a subject well worthy of being carefully worked out and presented every few years.

The therapeutic or irritating or toxic effects produced by materials that are or might be used for fillings, and the scope of therapeutic effort directed to the improvement or preservation of imperfect or carious teeth, are matters on which most of us should be glad to hear all that is now known, and especially glad to have additions made to the sum of present knowledge.

There are some things that are difficult, if not impossible, to be accurately understood by a description without seeing the thing itself; and if some one would carefully collect a number of skulls having teeth in the jaws, so as to include specimens of the different *typical* forms of teeth, from those with long bell-shaped crowns and small necks to those with short crowns and necks as large as grinding surfaces, and indicate, by actual cutting upon the different teeth, the forms of separations or contours most appropriate to be given to each in operating upon them, we might be able to understand gentlemen when they try to tell us how they separate teeth, or restore contours, or cut away at the necks, etc. Different teeth, in the same mouth, might be cut differently, to indicate the different treatment of teeth of similar shape, according as they should be found hard or soft, much or little decayed, in young or old people, etc.

A similar collection might be made for the purpose of being used as models for prosthetic dentistry; only it might be necessary to have the collection somewhat larger in number, since differences in the shape of the dental arch, and different arrangements of the teeth in the arch, would be of equal importance as the different shapes and sizes of the teeth themselves. The value of such collections would depend on the care taken to have the specimens essentially different from each other, and only so numerous that most of the mouths that we see would find an approximate representative among them.

The object teaching that could be done by the help of such collections would be very useful to most of us, and copies in plaster could be made that would serve an excellent purpose to any one who should carry them home after seeing the originals. The prosthetic dentist, who is a natural artist, needs to study models carefully in some way; and the one who is not an artist has no hope of success (that is worthy the name), except by closely following well chosen models. Perhaps, by taking impressions in plaster, models might be made from living mouths that would answer the purpose for prosthetic dentistry as well or better than the skulls, since they would show the forms of the gums as well as of the teeth.

It would be a useful service if some one would carefully watch the entire periodical literature of the profession through the year and bring to the next meeting a concise statement of everything new that had been brought out, with, as far as might be possible, a critical estimate of its merits or demerits. It might be worth while to consider whether work of this kind could not be most satisfactorily accomplished by a number of standing committees. For instance, one on dental literature, as just mentioned; one on new remedies and their uses, and novelties, in theories or facts, relating to the science and art of dentistry or in methods of practice; and one on inventions and appliances, whose business it should be to report *everything* of merit brought to the notice of the profession during the year, and who should be expected to stand between the Society and all the men who desire or undertake to use the Society meeting for the purpose of advertising some invention or appliance of their own.

I do not think it would be well to substitute the plan of having the Society work done by standing committees, instead of the present one, of essays prepared by individuals and arranged for by the Executive Committee; but if two or three papers, of the ten or twelve we can hear each year, were prepared by such committees as I have suggested it might possibly prove satisfactory.

Permit a few words as to the principles upon which the discussions in such an assembly as this should be conducted; and first, the larger the number of persons who will take part in them, the more general and sustained the interest is likely to be—always supposing that they have something to say which is not a mere repetition of what has been said before. In the next place the object in view is to impart and receive information, and not at all to obtain an argumentative victory. If this is kept steadily in mind it will help to prevent a discussion from ever degenerating into a mere dispute between two persons. It is therefore best, in most cases, having once made a comprehensible statement of views or opinions, to let it stand and take care of itself, with little effort to follow it up and defend it against contrary opinions or counter statements.

This is especially the case if the defense is to consist, as often happens, in a mere reiteration of what has been said in the first place—it is only an evident misconception of an *important* matter (not of a trivial matter) that calls for further explanation or restatement. It hardly needs mentioning that what is said should have some reference to the subject then under discussion; though it is not always easy to prevent a discussion from straying away, and it may probably be better for a presiding officer to be somewhat lenient than to call a member to order for such a reason.

I enter upon the duties of the office you have assigned me with the diffidence natural to inexperience, and bespeaking your good will and forbearance; but I have also the confidence, that comes from long observation of your good sense in parliamentary matters, and the frankness and mutual friendship that have always made the task of your presiding officer an easy one.

Gentlemen, I bid you welcome to the twentieth annual meeting of the Illinois State Dental Society; I am sure that the anticipations of receiving both pleasure and profit with which you have come here will not be disappointed.

EXPOSED DENTAL PULPS AND THEIR TREATMENT.

BY DR. S. F. DUNCAN OF WILMINGTON, ILL.

I have selected for my subject, "Exposed Pulps and their Treatment," not because I have anything new to present, or with the idea that I could say anything that would be instructive to such an intelligent body as is here convened; but it has been some time since we have had a paper on this subject, and so I decided to write a short one for you to use as a target at which to hurl your missiles of mature knowledge, from which I and other of the younger members may learn something of practical value on this important branch of dental pathology and therapeutics.

In the treatment of exposed pulps much depends on the health of the patient; his constitutional peculiarities, habits and idiosyncrasies; the condition of the mouth, teeth and adjacent parts; and the date of exposure, whether recent or remote. Pulps usually become exposed from one of the following causes: by accidents in excavating, by caries penetrating to the pulp chamber, by fracture of the tooth, or by abrasion. When a pulp has become exposed by accident in excavating, if not lacerated so as to cause hemorrhage, it may be capped immediately, and the operation of filling the cavity be proceeded with as soon as the capping has become sufficiently solidified to withstand the pressure of the plugger. But if we have bleeding, it will be necessary to control this before the capping process is begun, which may be done by applying some one of the milder styptic agents. In this class of cases the prognosis is usually favorable, if the capping has been skillfully performed and the constitutional health is good.

We many times find caries penetrating to the pulp cavity without the pulp ever having given trouble, and without its having suffered any mechanical injury. In cases of this kind the careful operator will usually anticipate the condition and use great care in the removal, with the excavator, of the superficial layers of decayed dentine; removing first, that portion around the margins of the cavity and not disturbing the layer of decomposed or semi-decomposed structure immediately overlying the pulp. This protecting layer should now be

treated to an application of carbolic acid or other antiseptic, sufficiently powerful to destroy the germs and ferments, thereby preventing further decomposition. This capping or protection should now be covered with the oxy-phosphate of zinc, else decay *may* go on under the filling of metal; the cement also acts as an insulator to protect the pulp from thermal changes, thereby preventing pain, congestion, inflammation and their sequelæ. This I regard as *the best* method of protecting pulps, when it is possible to do it, as the pulp takes much more kindly to a covering so nearly approaching nature's own protection than anything that art can substitute.

Pulps are encroached upon by caries in many instances, and even become slightly congested, without causing more trouble than just a slight uneasiness or an occasional sharp twinge of pain, which is usually caused by sudden changes of temperature, or the influence of chemical irritants, such as saccharine, saline or acid matters in the food. Little treatment is necessary in this class of cases, aside from the removal of all local irritants and proper protection against thermal changes.

We now come to the condition known as pulpitis, or inflammation of the dental pulp, which is *usually* caused by caries penetrating to the pulp chamber, thus permitting irritants, either chemical or mechanical, to come in contact with the pulp. Pulpitis may be of either the acute or chronic form.

Mr. Tomes says that ninety-nine cases in a hundred of inflammation of the dental pulp are caused in this manner. The sensitive nerves of the pulp thus being exposed to external influences cause an increased flow of blood into the part, and in proportion as we have an increased flow of blood into the pulp just in that proportion will we have diminished flow out of it; since, if the arteries are distended, the veins will necessarily be compressed or strangulated at the apical foramen. Of course the swelling is very limited, because of the confinement of the pulp within the rigid dentinal walls—thus the pressure becomes proportionately great, and also the pain, until complete strangulation occurs, resulting in disorganization of the pulp.

The more powerful the irritant, the sooner will this stage be reached. Inflammation is not always present in this active form, hence we frequently have patients tell us that they have had an

uneasiness or sharp twinges of pain for quite a while previous to presenting themselves for treatment.

Usually, when the stage of suppuration is reached and the orifice of exposure is free so as to permit the discharge of pus, the pain will subside as soon as the pus is evacuated, and only recurs from time to time, when excited by irritants or the reaccumulation of pus.

In the conservative treatment of this class of cases much depends upon the systemic condition of the patient, the condition of the pulp, the date of exposure, the size of the orifice of exposure, and the character of the irritant. If the pain is caused merely by irritating substances coming in contact with the pulp, little treatment is required further than the removal of all irritants, both chemical and mechanical, and properly protecting the organ from their further encroachment. But if this is not sufficient to relieve the pain, therapeutic means must be used, which should consist of the local application of such remedies as are best calculated to relieve the pain and reduce the inflammation.

Systemic treatment may also be resorted to with benefit, if the inflammation is severe.

If the patient is of full habit, a saline cathartic may be useful, or the tincture of aconite may be administered with good effect. If the pain appears periodically or is due to malarial influence, I know of no better remedy than the sulphate of quinine. This constitutional treatment also applies to pulps that are painful after capping.

It has been the practice of some operators to deplete the pulp by puncturing it with a sharp-pointed instrument, or by excising a small portion of it at the point of exposure, and encourage bleeding by the application of warm water, thus relieving the pressure on the nerves of the pulp and consequently the pain. But my experience with punctured or lacerated pulps has, as a rule, been anything but gratifying, either to myself or my patients; for while it may relieve the engorgement of the pulp-vessels at the time, and thereby give temporary relief from pain, yet I believe the statement made by our friend Dr. Stevens, at our meeting two years ago, to the effect that "few pulps that have been exposed so as to cause bleeding ultimately survive," was more nearly correct than some of us supposed.

I do not say that *all* pulps that have been thus exposed will die, but, as a rule, they will not become permanently healthy and useful organs. I think we are many times deceived by appearances, for after we have depleted the pulp, adjusted the capping, filled the cavity of decay, and have everything in a condition, as we suppose, "warranted to keep in any climate," what is our chagrin when, in a few months, the patient returns (or more likely goes to some other dentist) with his face swollen, saying that the tooth is a half inch longer than any other, and that it is so painful he has not been able to sleep an entire night for more than a week. He wants the tooth out and the operation completed without delay. We may explain to him that, with a reasonable degree of patience and proper treatment, the tooth may yet be made comfortable and useful, but we will probably find that just at that particular moment he is not in the least in sympathy with our ideas of chloroform and gutta-percha, and root fillings in general. And even if we *should* persuade him to submit to treatment, the question will naturally force itself upon us: Would it not have been better practice to have devitalized the pulp in the first place, filled the roots, preserved a better color in the tooth than we now have, retained the patient's confidence, and saved him an immense amount of pain and inconvenience?

Of course all pulps that have bled do not cause trouble of this kind, for many die under fillings without ever giving more pain than just a slight uneasiness caused by a low degree of inflammation in the pericementum, induced by gas from the putrescent pulp escaping through the apical foramen of the root.

In other cases the pulp may die under a filling without causing any pain whatever, but even then we have greater discoloration than would have resulted had the pulp been devitalized in the first place and the root properly filled; and, moreover, this discoloration is of no little importance if it occurs in a front tooth or a bicuspid.

When the inflammation has reached the suppurative stage, it has been the practice of some operators to extirpate the diseased portion of the pulp and then cap the remainder, after having brought it to as nearly a state of health as possible. This kind of treatment *may* be successful in a certain class of cases when done under favorable conditions, but we should certainly use great

discrimination in selecting a subject for this operation. On the whole I regard it as rather questionable practice.

Another method of treatment is by digesting away the diseased surface, leaving the clean, healthy portion for capping. Pepsin is the agent usually employed for this purpose, and is used in combination with hydrochloric acid. After the cavity is well cleaned and dried the remedy is placed on the exposed surface, and over the pepsin a pellet of cotton or bibulous paper. The cavity of decay should now be filled temporarily in such a way as not to cause pressure on the pulp. This may be done with wax, or what is better, a soft preparation of gutta-percha. It should remain in the cavity, under ordinary circumstances, for about twenty-four hours, at the end of which time the pulp should present a clean, healthy appearance, and may be capped and the filling introduced in the usual manner.

A decoction of the leaves of the pawpaw has also been used, to some extent lately, for digesting devitalized tissue, not only in diseased tooth pulps, but in obstinate ulcers and sores on other parts of the body; but being a new remedy it has not, as yet, come into general use for either purpose.

I believe Dr. Van Antwerp was the first to call the attention of the profession to this remedy.

I have had no experience in this method of treatment, but am inclined to doubt its efficacy for the permanent conservation of the remaining or healthy portion of an exposed and diseased pulp. A third method of treating such cases is by change of climate, *i. e.*, by devitalization; and though it may be regarded by some as heroic treatment, it is, in my opinion, the safest, surest and most satisfactory way, in the majority of cases, of treating pulps that have been inflamed to any considerable degree, or where they have been seriously wounded.

There have been a number of different modes suggested for the destruction and removal of dental pulps, from the use of that much abused remedy, arsenious acid, to the heroic treatment of driving a sharpened stick into the pulp canal to the end of the root. The latter operation should be deprecated as inhuman and uncalled for, not only because of the painfulness of the operation, but for the reason that it is, in many roots, impossible to reach the apex by this mode of operating. The use of the barbed broach

for this purpose is a more common method, but, like the "stick operation," is too painful in most cases.

In the devitalization of pulp tissue by therapeutic means there have been used a number of different agents, but as arsenious acid is the one *most* used for this purpose, it is the only one that will be here noticed.

I am aware of the strong prejudice existing in the minds of some of the profession against the use of arsenic for the devitalization of pulps, on account of its liability to produce soreness, by its irritating effect on the pericementum; to cause discoloration of the tooth; and the danger of its becoming absorbed into the system; and these objections have been magnified, until what is in reality a very diminutive specimen of mole-hill becomes like unto a great mountain. Hence, we hear some operators of good repute say "that they would rather fail by not using arsenic;" its use seems to them like pushing a drowning man further in—and other remarks equally forcible in their denunciation of the remedy, which, to me, seem unwarranted. So far as its becoming absorbed into the system is concerned, thereby producing systemic poisoning, I have never known of an instance of the kind; and even if it were taken into the system, I regard it of little importance if no more than just the requisite quantity is used, since it has been proven that the one two hundred and fiftieth part of a grain (gr. $\frac{1}{250}$) is sufficient for the devitalization of a pulp, while the sixtieth to the twelfth of a grain is the regular dose for internal administration; and in some instances a much larger quantity can be taken without producing any dangerous symptoms. It is also a mooted question as to whether the remedy is absorbed at all when placed in a tooth and sealed up. While some authors tell us that it is rapidly absorbed by the pulp and dentine, others say that the quantity absorbed is almost imperceptible; and, in proof of their assertion, cite us to that historic tenth of a grain which was applied to six pulps successively, producing devitalization in each instance, without perceptible loss of the agent.

While I admit that much damage may be done by the improper use of arsenious acid, yet I firmly believe that we lose many teeth that might be saved by its judicious application, its timely removal from the cavity, and by thoroughly cleansing and properly filling the pulp canals. The quantity used need be but very small if

applied directly to the point of exposure. It has been combined with other substances for the purpose of limiting its action and to mitigate the pain. Pulverized charcoal was formerly mixed with the arsenic for the purpose of limiting its action, but has now fallen into general disuse.

Arsenic is usually combined with the acetate of morphia and moistened with carbolic acid or creasote sufficiently to form a paste, which is applied to the point of exposure on a small pellet of cotton; the morphia is used for the purpose of preventing the pain caused by the irritating action of the arsenic on living tissue—though in most cases the carbolic acid is all that is necessary for this purpose. Some operators prefer to use the arsenic dry and alone, but in using it in this way a greater amount of pain is caused, and its action is less prompt than when combined with carbolic acid. It was formerly supposed that arsenic was soluble in creasote; but this, we are told by later authors, is a mistake.

In its application great care should be exercised not to cause pressure on the pulp, or pain will necessarily follow. As a rule, a rubber dam should be applied to the tooth and a sufficient amount of the dentine removed to fully expose the pulp, the arsenic applied, and the cavity sealed up with wax or gutta-percha. The use of cotton, saturated with sandarach varnish, I regard as insufficient in most cases for retaining the preparation in the cavity, as the patient is liable to get it out into the mouth and swallow it, which, if a large quantity was used, *might* result seriously; or, even if not swallowed, the tissues would be partially destroyed with which it comes in contact.

The remedy should be permitted to remain in the cavity for from six to twenty-four hours; the length of time depending upon the density of the tooth, age of patient, susceptibility to its effects, and the quantity used.

I have known pulps to become devitalized in from two to three hours. I also remember one case where several applications failed to accomplish the desired result, though its effect on the pericementum was very marked. The remedy should always be removed as soon as the pulp is dead, and the pulp-chamber freely opened, thus preventing discoloration of the tooth by the infiltration of fluids into the dentinal tubuli. The dead pulp is more easily

removed, if permitted to remain in the canals for a few days after devitalization.

In capping an exposed pulp after it has been brought to as nearly a state of health as possible, a material must be selected that is compatible with living tissue. For this purpose it must be non-irritant and a good non-conductor of heat, thus protecting the pulp from thermal change; it should be of such a nature as will not undergo chemical change after the operation has been completed; it should be of such consistence as to be easily manipulated, and when placed in position will not cause pressure upon the pulp and yet occupy all the space; it should be sufficiently resistant to withstand the pressure necessary in introducing and consolidating the filling of whatever material it may be.

As there have been suggested and practiced so many different methods of protecting an exposed pulp, and as nearly every operator has a *favorite* way of performing this operation, I will only notice here a very few of the many different modes that have been practiced.

Dr. Cravens was the originator of a method of treating exposed pulps by which it was desired to induce the formation of secondary dentine. After the cavity was thoroughly cleaned and dried, the point of exposure was covered with a paste, made by placing on a warm slab of ground glass a drop of Merck's lactic acid, to which was added phosphate of lime, thus forming the lacto-phosphate of lime. After removing the moisture from the surface of this capping of paste with some absorbent material, it was covered with two or three plies of bibulous paper, moistened with sweet oil; the cavity was then filled with os-artificial, using care not to cause pressure on the pulp. This should remain in the cavity for from two to six weeks, and one application is regarded as sufficient to induce a bony deposit to close the orifice of exposure.

The theory was, that the phosphate of lime applied in this way was appropriated by nature in forming the osseous deposit or secondary dentine for the protection of the pulp. I am unable to say as to the success of this treatment.

Another method that has been practiced to some extent is to shave, with a sharp excavator, from the healthy portion of the tooth enough living dentine to cover the point of exposure. I believe the theory is that the particles of living dentine form

centers of ossification for secondary dentine, just as the transplantation of small portions of the epidermis assist in forming healthy cuticle, or of small portions of the periosteum or bone to act as centers of calcification.

It is very desirable to obtain a protection of secondary dentine if it is possible to get it, as nature's own production would certainly be received much more kindly by the pulp than any artificial substitute.

There have been a number of artificial substances used for the permanent protection of exposed pulps, after having restored them to a comparative state of health. Disks of gold and lead were once employed for this purpose, but are now obsolete. A solution of gutta-percha in chloroform, collodion, oiled silk, asbestos and adhesive plaster have been used. The oxide of zinc has been mixed with different liquids to form a paste for the capping process, and is probably used in combination with creasote to as great an extent as any other preparation to-day. The oxyphosphate of zinc cement is also very extensively used for this purpose, and is a good material in the majority of cases. The oxy-chloride of zinc was formerly employed for capping exposed pulps, but has fallen into disuse among the more conservative class of operators, from the fact that its irritant qualities produced severe pain, and in many cases death of the pulp; even after the pulp has been protected by a paste of zinc oxide and carbolic acid, as has been recommended, it will, in many cases, produce intense pain, if not devitalization—and as we now have, in the oxyphosphate, a material in every particular superior to the oxychloride its use for this purpose should be tabooed by every conscientious operator.

Thanking you for your courteous attention to the reading of a poorly and hastily prepared paper, I will now leave the subject for your discussion.

DISCUSSION.

Opened by Dr. J. N. Crouse of Chicago:

In treatment of exposed pulps the first and most important step is to make a correct diagnosis of the case, to ascertain whether or not the pulp is exposed, and its condition. This is not always easy to determine. There are, however, some positive symptoms which

greatly assist us in deciding the first. Aching is one; hemorrhage another: the effect produced by the force of a stream of water thrown by a syringe into the cavity is a third. The latter will often indicate an exposed pulp when least suspected. Packing the cavity tight with cotton will also give evidence of an exposed pulp when it exists.

To determine when the pulp is in a healthy condition is a more difficult matter. One favorable indication, is freedom from pain when not exposed to the air or any irritating substance. Another and most positive symptom is sensitive dentine. If we take an instrument and cut the dentine at the junction of the enamel with the dentine [if an approximal cavity at the cervical margin], and the nerves from the pulp give off a good degree of sensitiveness, it is a pretty sure indication of a healthy pulp. This symptom is the one upon which I most rely in my practice. It is not safe to rely upon it wholly, because the dentine of some teeth has very little sensitiveness, whether the pulp is exposed or not. Good judgment and some experience are requisite, in suspected cases, in determining how much caries to remove.

If caries is progressing rapidly, the pulp will be reached quicker than when it is going on more slowly and ossific matter is being thrown out as a preventive against the approach of caries. In such cases the pulp will be found to have receded—nature's effort to protect it. In the case of a child or young person the pulp is much larger, and will be much sooner reached than in an adult. When you have reason to think the pulp is nearly reached, I would leave a thin layer of caries, preferring to cap over it rather than to take the risk of wounding the pulp by farther excavation. If the tooth is aching, of course the first step is to relieve the inflammation, which I first try to do by throwing warm water into the cavity, or applying tincture of aconite or carbolic acid. The latter I always use freely in the cavity before capping, for the purpose of coagulating the albumen over the point of exposure.

In regard to material, I think the manner of using the material of far greater importance than the material itself. My preference is for oxy-chloride of zinc. I am aware of the objections so frequently made to the use of this material, but in my practice have found them groundless. I prefer it because it can be more delicately manipulated than any material I have ever tried.

A point that should be well considered is the desirability of filling the tooth permanently immediately after capping, or, as soon as the cap is hard enough not to be disturbed by the packing of the gold. Whenever I find an exposed pulp in a healthy condition I adjust the dam, cap the pulp, and insert the permanent filling. By this method the danger of dislodging the cap in removing the temporary filling is avoided, and the patient is saved the pain of having the dam put on the second time. If we wait for results before filling permanently, we must often wait for months and even years before we can be sure the tooth will not give trouble. Patients often neglect to report, the temporary filling gives out, the cap is exposed, and caries commences again, thus endangering the life of the pulp the second time. It was not my practice formerly to fill permanently directly after capping, but later experience fully justified the practice. I have a record of cases treated by this method extending back over fourteen years, which cases I have repeatedly tested, and find the pulps alive and doing well. I do not claim for this method universal success, but my experience with it has been so satisfactory that I should want some very positive evidence that some other method is better before abandoning it. I am sure that less than one-tenth, I think I might safely say not one in twenty ever give trouble. I would not hesitate to cap an exposed pulp because the patient was in poor health. While I should not feel so sure of a good result, the results thus far, in my practice with this class of patients, have been so favorable that I would take the chances.

Dr. Patrick: I have found it difficult to destroy pulps with arsenic in some cases, even when no granulations are present which might prevent absorption of the agent. Theoretically, absorption might be promoted by the application of a hot-water bath, which would act by causing contraction of the blood vessels. I find difficulty in the treatment of exposed pulps of young six-year molars whose roots are not fully formed. My success in the capping of an exposed pulp which has bled has not been good. I would not expect a good result from capping over a coagulum of blood.

Dr. Eames: In hyperæsthesia of the dental pulp it is a nice point to settle just the point when it is healthy enough to tolerate

a cap. I think the condition of general health has much to do with the success of the operation; also age. I much prefer an old to a young subject. Orange wood stick sharpened to fit, and saturated with carbolic acid has proved very satisfactory in my hands as a root canal filling, particularly so as regards the freedom from soreness after the operation.

DR. BLACK: I began capping pulps in 1858, and, with an intermission of two or three years, have kept up the practice ever since. It is important to properly select cases, to differentiate between a healthy and a pathological state. In undertaking cases I would risk much more in order to preserve a pulp for a child than for an adult. In early life the foramen is larger; greater danger of abscess; dentine is less strong. The pulp grows less important as age increases. We have better success in treatment of young cases on account of easier formation of new dentine. A coagulum under the cap is not necessarily fatal. If the pulp is reasonably healthy, the blood clot will be dissolved by a digestive agent and absorbed as readily as if in any other part. Carbolic acid will render the coagulum more difficult of digestion. Since abandoning the use of carbolic acid and oxy-chloride of zinc, I have had larger per cent. of successful cases. In capping with oxy-phosphate I cut a piece of paper to fit accurately over the part to be protected, mix the cement on a *cold slab*, place a sufficiency on the paper, and carry it to its position over the pulp. The warmth of the tooth makes the cement more plastic, and the paper prevents it from sticking to the instrument.

DR. C. W. SPALDING: More than thirty years ago, when we knew but little of the pain obtunding power of carbolic acid, I was driven to its employment in extracting live pulps, and that with comparatively little complaint from the patient. I wish to add my testimony in favor of this process. In destroying pulps I use arsenic and morphia equal parts, which is prepared by triturating them together for half a day. That I use was prepared thirty-five years ago—it is very efficacious, and I have introduced it with safety to the apices of teeth. The morphine is introduced to permit of the extreme subdivision of the arsenic, not for its narcotic property.

Dr. Sitherwood: While Dr. Crouse is successful with oxy-chloride, Dr. Black with oxy-phosphate, and some others with gutta-percha for pulp capping, much depends on the skill of the operator. The lives of many pulps are sacrificed to faulty instrumentation.

Dr. Newkirk: We know that wounds in some persons heal with great difficulty. That particular condition of the blood or health would effect the healing of a pulp also. If a pulp is healthy, half the battle is won. My method of capping is similar to Dr. Black's, except that I apply the cement with the oiled end of a probe instead of using paper. To cap over a bleeding pulp is not good practice—it produces a form or condition of thrombosis. I use a solution of nitrate of silver for cauterizing an exposed pulp.

Dr. A. W. Freeman: I do not remove the pulp till from two to five weeks after the application of the devitilizing agent.

Dr. Ingersoll: My views on this subject have been very fully expressed in the journals. All agree in this, that a pulp should not be capped while in a state of inflammation. I have not the same difficulty in determining the fact of inflammation that my brother Crouse seems to have. It may be assumed that no pulp is in a healthy condition that has been exposed by the slow process of decay. Such a pulp, therefore, is not in a condition for capping until it is restored to health. It should be remembered that no organ of the body has such a feeble hold on life as the dental pulp. The slightest irritation often causes death. As age advances, nutrition is gradually lessened by the apical foramen becoming smaller and smaller, so that the tendency of the pulp is to obliteration. With increasing age and the increased density of the dentine, the pulp becomes less and less valuable to the tooth structure. I am asked concerning my use of dialysed iron. I use it, after removing the arsenical paste, to neutralize the arsenic that may have entered the substance of the pulp, and remaining there will prevent its decomposition, as arsenic is one of the most powerful antiseptics known. My object is to secure the most speedy decomposition of any remaining portions of the pulp which cannot be removed mechanically. Furthermore, I wish to neutralize the arsenic that may remain adhering to the walls of the cavity, and may be washed

out to inflame and destroy the root membrane; as the pulp being dead, all the life and value of the tooth resides in the peridental membrane, which should be guarded with the utmost care.

DR. BROPHY: The diagnosis of these cases is not always clear, as Dr. Black says we must determine when a pulp has passed from a physiological to a pathological condition. If, by accident in excavation, a pulp is exposed, I should cap immediately. If, however, the pulp had ached somewhat during the past few days, I should defer it, for the pulp would then be hyperæmic and congested. I do not consider it good practice to cap a pulp which has disturbed the patient for a period of five or seven days. A tooth in which the roots have been skillfully filled is better than one which has a capped hyperæmic pulp. I regard the application of carbolic acid to produce a coagulum on the surface of the pulp as bad practice—we should avoid everything which may produce irritation. I find listerine an excellent agent to promote a return to health in the pulp. Iodoform is another meritorious remedy. I use arsenic for devitilization, but hope for something better to attain this end; possibly electricity. The pulp is not destroyed so easily as we were taught at college. I find it necessary to leave the arsenic in the tooth from two to five days; if but a small part lives at the apex, extirpate with a white hot needle—a painless operation. The canal may then be filled with no danger of pericementitis. I do not consider it best to try to save a partially dead pulp.

DR. NOYES: It seems to me that this is the most satisfactory discussion on pulp treatment I have ever heard. It has taken a wider range, and noted a greater variety of conditions and methods than usual. The experiences and results described by some of the different speakers are apparently contradictory; one having the most gratifying success in the use of oxy-chloride of zinc cappings, and another never using it and finding in his practice great numbers of dead pulps under such cappings made by others. These different results can be explained, at least in part, by the varying conditions and susceptibilities of the pulps capped, and especially by the delicacy, skill and good judgment, or the want of them, in the manipulation and management of the material. A slight amount of stimulation or irritation applied to an exposed pulp, which

happens to be in a condition to respond to it properly, will be followed by increased nutritive activity, which will promote its healing if wounded, or the deposit of secondary dentine to close the orifice of exposure, or *possibly* its recovery from a state of low grade chronic irritation. The success with cappings of oxy-chloride depends upon so managing the operation, and suiting the method of manipulation to different cases, that the irritation from the chloride of zinc shall be enough to provoke this nutritive activity, and not sufficient to cause injurious inflammation. The antiseptic qualities of the zinc chloride are of undoubted value also. The treatment of a pulp does not differ materially in essential principles from that of any other wounded or inflamed part, but the delicacy and susceptibility of its structure, its confinement in bony walls, and the minuteness of the foramen for the access of its nutrient vessels, very greatly increase the difficulty of its management when wounded or diseased. A freshly wounded healthy pulp, in a healthy person, needs only the use of a non-irritating antiseptic and careful protection, and it will then heal by first intention, as any other small wound would for such a person. Whether a particular pulp needs only an antiseptic and protective treatment, with careful avoidance of all unnecessary irritation, or whether it will be benefitted by stimulation or irritation by oxy-chloride of zinc, must be determined by the judgment and experience of the operator.

Dr. Cushing: I wish to emphasize a few points. Greater success is attained in the treatment of teeth of young persons, because all reparative processes are better performed during the period of growth. I am pleased with the stress laid upon the necessity for a good condition of health of the patient. This is an essential factor in the treatment. One reason of failure to preserve pulps is lack of care in manipulation. Some would be wisest not to attempt the operation of capping. The results, too, are often disastrous when the conditions seem favorable. It is especially desirable to save the pulps in the anterior teeth of the young. Just in proportion as the person's age is beyond maturity, success in capping exposed pulps is lessened. The result after thirty-five years of age is doubtful; beyond forty, success in individual instances only is attained. During growth the case may recover in spite of considerable inflammation.

DR. BLACK: I am glad Dr. Cushing has spoken of the more active condition of children—greater recuperative power. There are conditions which militate against immediate capping. In cases where a scratch on the surface heals slowly the pulp will not stand capping. Many men are inclined to abandon this operation, because a case occasionally comes back dead or ulcerated. I have had these cases, and every practitioner in this room has had such cases, where there has been no exposure. I have not examined my records, but I think I have more such cases than of capped pulps.

DR. CROUSE: The manipulative ability of the operator has much more influence on the success of these cases than the variety of material used.

DR. HARLAN: Those who expect success to follow the capping of exposed pulps must bear in mind that all foreign matter should be removed, and the cavity thoroughly dried, so that the oxyphosphate will adhere to the walls. In recent exposures use no escharotics or irritants; anodynes and soothing applications are best. I believe in trying to save the pulp in all young subjects, but am not so sanguine of success after the patient has arrived at the age of forty or upwards. I am not in favor of immediate capping, as it is best to wait for several weeks or months before inserting a permanent filling, because it is much easier and more convenient to retain temporary fillings for a period than to run the risk of removing a gold filling. As a dressing for inflamed and aching pulps I use a thick paste of pulverized iodoform in the true oil of cinnamon, which is stimulating, antiseptic and anæsthetic. Apply over pulp; cover it with bibulous paper without pressure; seal the cavity, and direct the patient to return after a week. Repeat application, if necessary, and allow a small portion to remain in direct contact with the pulp when you cap. Always thoroughly dry the paste before introducing the capping material.

REFLEX PAIN.

BY KATE CAMERON MOODY, D.D.S., MENDOTA, ILL.

After having nearly completed this paper I learned that Dr. Newkirk had presented something in the same line of thought a few years ago before the Society; but, as it is a subject of a great deal of importance to us all, and upon which very little has been said, it seemed that a change of topic was not best.

When first entering upon active duties in my profession this was one of the most formidable mysteries I had to encounter; the complex nature of which was only equaled by my disappointment at finding so little, in all our literature, to give me light.

The common use of the word "reflex," as we all know, is the name given to that influence which, when exerted upon the periphery, or terminal branches of a nerve, is conveyed to the center by an afferent, or sensory fibre, to be "reflected" by an efferent or motor fibre; the reflex impulse being one of *motion*, and not of *sensation*. An example: We take hold of a hot iron; the impulse conveyed to the center gives a sensation of pain; the center immediately sends out an impulse through the motor fibres which causes the muscles to contract, and we drop the iron. This is "reflex" action, pure and simple. But there is another application of the word which is quite commonly made, and which is employed here, namely, the designation of perverted nervous function, which occurs simultaneously with phenomena produced by other than peripheral irritation—the difference being that the reflected impulse is one of sensation instead of motion, also called sometimes *sympathetic* pain; though it has been doubted by good authority whether the sympathetic system is capable of transmitting such influences.

There are three great centers of reflex action—the brain and cord, the stomach and digestive apparatus, and the reproductive system. When any one of these centers is disturbed the influence is likely to radiate in any and all directions. In this way disease may arise in portions of the body quite distant from the true seat of irritation; hence the difficulty in diagnosis when judging from the locality of the symptoms. If there be over-excitement or

worry of the mental faculties, it does not necessarily follow that the *head* will be the first to cry out in pain; there may be disturbance of the *stomach* instead, or, if the digestive organs become disarranged, the head may be the first to give notice. Thus it is that, in attempting to cure disease by removing the cause, we sometimes find ourselves in deep water.

We have always been taught to define pain as "an impingement upon a nerve." Let us consider it in the abstract. Physiologically, what is it? or, shall we say *pathologically?* for there can be no such thing, of course, as physiological pain. What is that condition of the nervous system which our consciousness interprets as "pain?" Is it, as some claim, only an excess of ordinary sensory function? The function of any organ or tissue is the work it does when in a healthy condition. The work of the nerve is to convey impulses to and from the center; then, if some other than normal work is done by a nerve, we conclude that something is wrong, some change *somewhere* causing this perverted function.

It is within the delicate mysterious chambers of the brain where resides this hard-to-be defined influence or sensation we call "pain." It is here the change from afferent to efferent impulses takes place. When, therefore, pain is felt in a part, as the result of reflex influence of some remote diseased part, may not the fault lie in the *center*, which fails to transmit correctly? thus making the secret of reflex pain a *psychological* and not a *pathological* one. How, otherwise, explain the instantaneous relief from reflected pain on the removal of the real cause? Can there be real molecular changes existing which would cease immediately, without time for the usual repair of tissue necessary to complete absence of pain? Tuke, in his "Influence of the Mind upon the Body," says: "Emotional impulses may act upon the sensory ganglia and nuclei of the nerves of sensation so as to produce any of those sensations which are ordinarily induced by impressions upon their periphery; such sensations, although central, being referred by the mind to the peripheral terminations of the nerves."

To return to the work performed by the nerves. In what does this change of function consist? The cutaneous nerves convey to the center a sense of comfort when the surrounding atmosphere is neither too hot nor too cold; but let these same nerves be exposed

to a cold wind, and quite a different sensation is produced, which causes the reflex movements of shivering, or, if long continued, of aching pain. In the same way intense heat, when applied to the surface, will cause pain. Now, both heat and cold produce an agreeable sensation when applied in a certain degree to the surface, but an entirely different sensation when the degree is increased. So we see that if a force which produces an agreeable sensation be increased to a certain extent, the result is a sensation of pain. Then does it not seem that the difference between comfort and pain is one of intensity only, *quickened impulses*, just as the difference in wave lengths of light will produce different colors; or may not the different results produced by nervous impulses be due merely to a difference in wave lengths of the impulse—or, in other words, only a "mode of motion?" A nerve, like a faithful messenger, is going about its daily duties, performing its normal functions—an impingement occurs—*it merely hurries up to tell the news!*

It is not necessary that any tissue of the body should be putting forth its greatest effort when producing normal results. Nature has provided, in various ways, against accident and disease in our bodies. A blood vessel is not distended to its utmost when simply carrying the blood at a normal rate; the large sinuses of the brain provide against an engorgement or obstruction in that important part; the heart possesses a capacity which permits great acceleration of motion in case of excitement; the lungs, likewise. A man may walk three miles in a leisurely way and feel refreshed, but if he put forth extra effort, and walk five miles in the same length of time, he will become fatigued, although he use the same muscles for the work. But what of the nature of this force? Who shall say. Will scientists finally solve the question?

In a recent scientific journal the similarity between nerve force and electrical force is discussed, and their identity well nigh proven, or, at least, nearly enough so to make the theory seem a very plausible one.* This, in connection with the late experiments of Prof. Hughes of England, by which he has shown all matter to possess an inherent property, manifested to us, under certain conditions, in the phenomena of magnetism and electricity, makes a

*Scientific American, May 3d, 1884.

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strong argument in assuming this nerve force to be but another manifestation of this same mysterious property common to all matter.

It is through the vast net work of nervous structure, interwoven, crossing, recrossing and uniting, like lines of telegraph, in every part of the body, that these impulses are constantly being conveyed; their connections and relations being so intimate that one portion of the body can not suffer alone but a deep sympathy is found to exist in the surrounding parts, and if the injury be great the whole body is involved. Whether these impulses are conveyed entirely by the sympathetic system of nerves, or whether through the continuity of fibres at the origin of the main nerves, is a question. It is a fact that the fibres of some of the main nerves may be traced to the same point in the medulla, either in their deep or superficial origin. Anstie speaks of the close juxtaposition and intimate reflex relation existing between the roots of the fifth cranial and pneumogastric, so that the impressions made upon the fifth, in extracting, exert a powerful stimulating effect upon the pneumogastric. Why may not the pain in the stomach and œsophagus, "the lump in the throat" of hysterical patients after an operation be due to the same cause? Irritation of the fifth has been known to cause violent fits of vomiting and cardiac pains, as in the eruption of the third molar.

Of all nerves in the body the fifth cranial is the most interesting to us, as dentists, not merely because its branches supply the dental organs, but because it is most often the seat of neuralgic affections, with the exception perhaps of the sciatic, and when thus affected, yields less readily to treatment than any other nerve. Also, owing to its large and much exposed peripheral expanse, the complex nature of its functions and its close connection with other important nerves, its affections are most likely to cause secondary or "reflex" disturbance of wide extent. Without taking this into consideration, it would seem strange that cervico-brachial neuralgia, or disturbance of digestion, should be caused by carious teeth. Yet not only these, but parts more distant will often become thus affected. There seems to be an especially close relation existing between the teeth and the reproductive organs, and, at times, when the latter are peculiarly engaged, it is not an uncommon occurrence for us to be called upon to treat perfectly

sound teeth, though of course more often unsound ones. Again the careless, or shall we say *ignorant*, practitioner, will sometimes remove a sound tooth without relief to the patient, when the true cause of the trouble may lie no further away than the opposite side of the mouth. Simply because a person, almost insane with pain, demands treatment of a certain tooth, is no reason why a cool-headed dentist should not make a thorough examination of not only all the teeth, but, by using his knowledge of nervous distribution, inquire into the the general systemic condition. We do not wish to be understood as asserting that such an examination and inquiry will invariably bring to light the lurking cause, but that the removal of an obscure cause does, very frequently, produce the desired result, is sufficient reason for the exercising of more care, yes, *more knowledge* than is sometimes used.

I am aware that the temptation is sometimes strong to use our skill only so far as we are compensated therefor; and yet, is it the highest aim of our profession to accumulate wealth? Is there not a more noble object to be gained, namely, the alleviation of suffering, as well as the more selfish one of self-improvement, in adding to our knowledge of the delicate structures under our care? We cannot be too well informed on these things; besides, it behooves us, as specialists, to not only post ourselves on what others have found out by experiment and investigation, but also to experiment and investigate for ourselves. Let us not leave it to the medical profession to prepare our food for us, being content with opening our mouths to swallow the bolus when ready.

An eminent medical authority, in his review of the state of ophthalmology for the year 1883, says: "The influence of carious teeth in producing affections of the eye is neither sufficiently considered nor understood. The relation between the two is often very noticeable."* Do not we, as dentists, share this implied reproach upon the medical profession? We are willing enough to confess our ignorance; but this is not sufficient. Let us "*observe, compare, reflect, record.*" There is ample room for research upon this one subject of "reflex pain." As I said before, the meagerness of our literature upon this subject, to one in

*Report on Ophthalmology. S. J. Jones, A.M., M.D., Chicago, 1883.

search of facts, is very striking. It cannot be that there are not frequently occurring, in our many dental offices, such incidents, which, if recorded, with the results of proper research, would help many another, who may be puzzling over the strange occurrences which baffle all his skill. Let us honestly and faithfully record the results of our research—not being too fearful of criticism—and thus help to diffuse the knowledge we all need. If you have a patient with an inflamed and painful eye, which has refused to be comforted by all other treatment, but is immediately relieved after the treatment of a carious tooth, don't keep the good news to yourself, but "call your neighbors in." and divide; after first satisfying yourself as to the probable reason of this sympathetic action between the different branches of the nerve, whether it be due to want of tone of the system, or to whatever exciting or predisposing cause, make a short and concise note of it, and send it to one of your journals, which will gladly assist you in your efforts to do good by publishing it.

DISCUSSION.

Opened by DR. T. L. GILMER of Quincy:

The contemplation of such subjects as these must convince us of the importance of a more general knowledge of the entire human system, and its workings both in health and disease; as the associate pathological conditions accompanying dental and oral irritations are various, sometimes leading us to distant organs for a solution of the difficulty. What is the extent of the dental specialists' field? Where is the dividing line which separates the physician and dentist? are questions which often present themselves to my mind. Are we to trace the nerves supplying the teeth to the Casserian ganglion and stop? Are we to follow the arteries of the teeth to the carotid, and stop? If so, our field is indeed limited. But I do not believe this is true; I think our territory is co-extensive with the physicians'. He should come to our special field when necessary, and we should, if we may find the way, go into his field, just so far as may be necessary to determine whether the dental disturbance be simply symptomatic or truly idiopathic. If we have sufficient wisdom, we may greatly aid other specialists

in seeking out the exact location of the primary lesion—this is particularly true of oculists and aurists. Irritations in the peripheries of the dental nerves may be reflected along the various distributions of the fifth cranial and its anastomotic branches to the eye, ear, and sometimes to more remote organs. The uterus and other visceral organs are widely separated from the teeth, but the sympathetic system is so intimately connected with the three great divisions of the fifth that these organs may, at slight irritation, make scapegoats of the teeth, palming off their own disabilities upon them. While I am fully convinced that irritations of distant organs may cause pain in the teeth and in other peripheries of the fifth, still I further believe that the majority of neuralgias and aches of this nerve are caused from truly dental or posterior nasal disturbances.

In looking for the cause of pain located by the patient in the teeth, we must not be in too great hurry to leave our special field; a thorough investigation must first be made in the oral cavity, and then, if we conclude there are no diseased conditions in and about the teeth, it is time to investigate beyond, but not until every nook and corner is carefully inspected; as before said, the great majority of pains about the mouth come from some local irritation. It is thought by some that much of the pain supposed to be reflected from the uterus is not a truly reflected pain, but an essential pain, caused by a vaso-motor disturbance, which causes dilatation of the arteries, making pressure upon the nerves in their walls. The calibre of the arteries of the teeth is controlled by the carotid plexus of the sympathetic. This plexus is given off from the superior cervical ganglion; from this point follow the spinal sympathetic down to the hypogastric plexus, and we establish a relationship between the two widely separated organs. The afferent vaso-motor fibre of this system would transmit impressions made upon them by a diseased uterus to the vaso-motor center in the medulla, and by efferent fibres be returned, in reflex relationship, to the carotid plexus through the superior cervical ganglion. The irritation of a vaso-motor nerve may, at times, cause a dilatation of arteries by diminished inhibitory nerve power in a correlated area. This being true, a lack of tone in the arteries of the teeth might be caused possibly by a displaced or otherwise diseased uterus, and the pain which we are accustomed to think of as reflected, may not, strictly speaking, be a reflected pain at all. So, also, might

we account for the ravages of decay frequently accompanying pregnancy. Any of us might cite case after case of diseases of the teeth affecting the eye and ear; in fact, I have here a tooth which I extracted for a lady with amaurosis, whose sight was speedily restored following the removal of the tooth. She was not aware of any trouble in the tooth whatever. We see these cases and cure them, but which one of us can, to a certainty, explain how this eye was made blind by this exostosed and otherwise diseased tooth. We may be able to designate the road traveled by the irritation, but what is the condition of the cells of the center which became so confused as to be unable to designate the true locality of the lesion. Very much is known of the nervous system, but still much remains hidden from view.

Neuralgias caused by irritations of the peripheries of the fifth cranial, I find, yield readily to the green tinct. gelsemium, in doses of from five to twenty drops, exhibited every two, three or four hours, as the urgency of the case may demand, until pain ceases, or the physiological effect is produced. If it be a pain reflected from a distant organ, it seems to be of little value, having its principal effect as a pain obtunder on the fifth cranial nerve. In fever or irritation of the nervous system, with strong tendency to the brain, flushed cheeks, bright eyes, contracted pupils, hot skin, it is the remedy of all remedies. It is not without danger, and should be handled with care; but I imagine where it has proven fatal it was given when it was contra-indicated, that is, where there was a blanched countenance, eyes dull, pupils dilated, cool skin or imperfect capillary circulation. It has been condemned by some as a neuralgic remedy, on account of a lack of uniformity. This may be because it has been given indiscriminately to all classes of neuralgias, and I imagine that the cases where it was properly administered and failed were in reflected pains and not in peripheral irritation of the fifth. Quinine seems to be the remedy in reflected pains. There seems to be no doubt but that this drug diminishes reflex action, it is supposed, by a stimulation of the cardiac peripheries of the pneumogastric.

I feel honored to have been selected to open the discussion on this excellent paper, and in conclusion must say, if this be the character of papers which lady dentists can write, give us more lady dentists.

Dr. A. W. Freeman: No nerve is independent of all the others. In my early practice a lady called on me, requesting that all her teeth be extracted. They were very loose, but not decayed or crusted with tartar. I was surprised at their condition, especially as the lady was young and seemed in good health. Reflecting a moment I sent her away, that I might study up the case; until I could get more light. My knowledge of medicine taught me of the great changes child-bearing produces upon the mothers' teeth; and learning afterwards, what was thought improbable at first, that the reproductive organs were so engaged, we concluded it was best to leave the case without treatment. As the generative disturbance lessened, the dental trouble gradually disappeared.

Another case was that of a child afflicted at various times, while teething, with bowel derangements and nervous twitchings of the limbs and muscles. This chorea passed entirely away upon the full eruption of the temporary teeth. It has now partially returned, as the patient is getting her cuspid and bicuspid teeth. It will probably disappear with completed second dentition.

Still another confirmation of the paper I find in the case of a prominent physician of this State, who suffered severe neuralgia, at times, for several years. The masseter muscles became rigid and the mouth was closed to all but fluid nourishment for a long time. The passing of the hand of a strongly magnetic person on one side of the face provoked spasms of pain, and thus the region of disease was discovered, and a tooth, not ulcerated but filled with amalgam, was pried out of the mouth. The neuralgia ceased, and the muscles resumed their normal state after the extraction.

Dr. Black: There is a close relationship between reflex pain and reflex motion; they are of the same order of phenomena. It is conceded that neuralgia results from anæmia—insufficient nutrition of the nerves. Yet we may have neuralgia in persons apparently not anæmic. This may be brought about through the vaso-motor system of nerves, through tension localized in particular parts, producing narrowing of the vessels supplying the part with blood—a local anæmia. It will be seen that this form of neuralgia may occur in a part, through reflex action implicating the vaso-motor system of nerves supplying special parts. Irregularities in the circulation in the two sides of the brain, from such a

cause, may cause giddiness instead of pain, and other phenomena that may be difficult to explain. By this theory we may understand why those remedies that act on the vaso-motor nerves cure or relieve neuralgia. If we analyze the remedies we have found best, it will be seen that their action may be explained by reference to their power of correcting local disturbances in the circulation—relief of local tension. However, we have no exact knowledge on this subject. What we have is more or less speculative.

DR. PATRICK: We see by the latitude of this discussion how difficult it is to confine or circumscribe investigation, even in our specialty. "No pent up Utica confines our power." It is an ultimate fact in nature that consciousness is the result of stimulated nervous tissue; we know that we smell with our nose and see with our eyes; we cannot smell with our ears or see with our tongues; and yet the gustatory and auditory nerves are, in substance, like the optic and olfactory. This difference in function is evidently in the arrangement of the nerve cells, and the disposition of the channel through which external agents have to travel in order to reach them. We constantly feel, in spite of ourselves; it is impossible for us to avoid having sensation when any object excites the nerves; the sensation is within us, but is dependent on external influence. We receive it, but how? It is evident that there is no connection between the words which I utter and the impression which my words have upon your brain; and how diversely the same words will effect different individuals. Witness the effect produced on the mind and body of an individual, surrounded by a gay and happy company, who receives a telegram from the hand of a messenger, the few lines of which convey to him the intelligence that a great calamity has befallen his nearest and dearest friend. The shock throws him into convulsions; his friends endeavor to pacify him; he is completely prostrated; a fever sets in; he is delicate for weeks, but finally recovers. His friends sympathized, but were not afflicted in the same way; they saw the same characters on the scrap of paper; those characters were reflected on their retinas in precisely the same manner, and were governed by the same laws that impressed the characters on the retinas of their unfortunate friend, yet how different the result on the nervous system.

The property of a nerve cord to receive an impression and conduct it inwards is common to all nerves; but there are certain nerves that not only have the property of receiving and conducting an impulse inwards, but also have the power to return the same impulse outwards. These are ganglionic nerves, and are distinguished from all others by nervous knots composed of gray matter, which knots distinguish them physiologically as central organs from simple nerves, and endow them with the power of reflex action, whether of pain or pleasure. The reflex power is possessed by the gray matter and not by the white substance of the cord. The afferent impulse being converted into an efferent impulse, producing what is called reflex action, is beautifully illustrated in the expansion and contraction of the iris in accommodating itself to the vibrations which produce the sensation of light. When the light passes through the central opening of the iris, or pupil, and thence through the lens to the retina, it is received by the nerves of the retina on its concave surface. Now, if the light be too strong, the small ganglia, connected with the nerves which control the movements of the iris, instantly transmit an efferent impulse which contracts the pupil and shuts off the light. If, however, the luminous vibrations are not sufficient to produce an ordinary sensation of light, as in a dark room, the iris is expanded and the pupil is enlarged by the same process of reflex action. The points of a star-fish are supplied with nerves and ganglia to produce reflex action. Touch one of the extended points of a living fish and the impulse is carried towards the center, to the ganglia controlling the point touched, when the ganglia at once returns the impulse to the muscles, which immediately contract and the point curls up. A similar phenomena is produced when a frond of a sensitive plant is touched; the frond, however, having no muscular fibres to contract, simply droops. Are these ganglia that we find in plant and animal, that bring about such definite action, endowed with intelligence? or, are all these phenomena merely manifestations of chemical and mechanical energy? When we pass beyond the boundary of physics into the region of metaphysics, we are as men born blind discussing the nature of light.

THE ORIGIN OF DEFECTIVE ENAMEL.

BY W. H. EAMES, D.D.S., OF ST. LOUIS, MO.

At your last annual meeting I had the pleasure of presenting before this Society a short introductory paper on the subject of defective enamel structure. It embraced a synopsis of the views of the most prominent writers upon the subject, together with some objections which have presented themselves to my mind in the study and investigation of this question.

Time did not permit a full discussion of the subject, and now, in fulfillment of a promise made to the Society, I bring the subject before you again in the following brief paper, in which I have endeavored more fully to present my views. The theories entertained by all writers of the present day, as to the cause or origin of defective enamel structure, differ but little, if any, from their predecessors, writing perhaps a century earlier.

It seems to be regarded as one of the settled facts of our science, which, like the traditions of the church, it were heresy to dispute; it is set forth in all our text books, and taught in all of our colleges; but, notwithstanding the general acceptance with which it is met at the hands of all succeeding students, it seems to me that, whether it is capable of disproof or not, there is reasonable room for doubt at least—and while I do not expect to present a solution of the phenomena of these various formations which shall be accepted as true without question, I do hope to illumine some of the darker places in the misty theories of the past.

The various forms of defective enamel which, up to the present time, have been known as rocky, ridged, furrowed, cribriform, pitted and grooved enamel, attributed to one cause, viz., arrested development, will be considered under two general heads, "Congenital" and "Non-Congenital" or accidental. The first class, "Congenital," will include all of those defects which are supposed to originate during the formative period of the tissue; the second class (non-congenital or accidental), those forms which originate after the complete development of the tissue.

Thus the first class, or congenital, will comprise some of those forms known and described as rocky or ridged enamel; simple pits

in the structure more commonly found on the points of the cusps, but existing often on other portions of the tooth, and especially noticeable in cases where but few of the teeth are affected: grooves or fissures in the coronal surface of the bicuspids and molars. The second class (non-congenital or accidental) will include some of the forms of grooved or furrowed teeth not considered in class first, described by Mr. Hutchinson and others as due to syphilis, mercury, etc.; also, cases presenting the same characteristics which occur later in life, in the form of grooves at the gingival border of the molars and bicuspids, usually considered as cases of erosion, abrasion, denudation, atrophy and caries, which, in my opinion, have a common origin.

The origin of the first class, as I believe and hope to demonstrate, is not due to constitutional disturbances affecting the epithelial structures, such as measles, eruptive fevers, mercury, syphilis, eclampsia, etc.. which are supposed to cause an arrest of development and a consequent defective enamel structure, but to a defect in the formative organ, which might, in cases of pits, be termed a blight or death of the ameloblast, or in cases of fissures a "rupture," being the result of a separation of the ameloblastic layer.

Let us glance at the process of development at this period. According to the best and latest authority on this subject the enamel organ envelopes the pulp or dentine organ in the form of a hood, corresponding somewhat to the form of the future tooth. It is composed of three layers or strata: an external and an internal epithelial layer, and a reticular layer; the external and internal layers are formed of the columnar cells of the malpighian layers of the epithelium. The internal layer of cells or ameloblasts, having undergone a change in length, are much longer than the cells composing the external layer. To the cells composing the internal layer I have given the name *ameloblasts*, as to them is delegated the work of forming the enamel in the same manner as the odontoblasts form the dentine. Just how this process of amelification takes place is not definitely determined. Whether it be by direct impregnation of the cell or by exudation is not essential, so long as it be admitted that the formation of the enamel is dependent on the presence of the ameloblasts. The recent explanations of the phenomena of enamel formation by Prof. Bödecker,

Williams and others, if true, might affect the position taken in this paper, but being in advance of the accepted theories up to the present day they will not be considered.

There is no class of cells more liable to a change of a retrogressive character than the epithelial, and none develop more rapidly. We have seen that the enamel organ is made up of this class of cells exclusively, and is therefore subject to changes noticeable in epithelial structure; elsewhere a blight or death of one or more of the cells of this organ may be looked for at any time. If one or more of the ameloblasts die, or from any cause be wanting in the internal layer of the enamel organ at any point, then will there be a missing rod or rods corresponding in number with the missing ameloblasts, thus forming a circular pit. If the ameloblast was missing when the process of amelification commenced, this circular pit would extend from the external surface of the enamel to the surface of the dentine beneath; but if the cells die after the process of amelification is partially completed, then the depth of the pit will correspond to the length of the rod which was left unfinished; the cells surrounding the missing one being unaffected would complete the work assigned to them, and thus the walls of this pit will be normal in character, except, perhaps, in cases where the direction of the rods is slightly changed. Thus is formed the pit described by Wedl and others, an opening surrounded by enamel rods and the bottom clothed with enamel.

The change which takes place in the walls of these pits from the action of external agents, acids, bacteria, etc., after the tooth is erupted, would result in the forms figured by Wedl and Magitot, and by them described as being filled with pigment, debris of tooth substances, food, leptothrix, etc. The breaking up of the rods forming the walls, giving the pit the form of a pouch or cul-de-sac, may be accounted for in this manner. It may be claimed that this would be but a form of arrested development, especially as this process of amelification is one step in the process of development; but can it be called an arrest of development "dependent upon some constitutional disturbance," as Wedl, Magitot, Tomes and others assert? We think not. It is not an arrest, but a death or blight of a cell or cells forming the enamel rods, independent of any systemic or general constitutional disturbance.

The next form to which I would call attention, fissures or grooves in the coronal surface of molars and bicuspids, is also accounted an arrest of development, a lack of coalescence, a failure on the part of the enamel plate, which, in its development from the cusps toward the center, fails to meet and coalesce. To Dr. Black of Jacksonville, belongs the credit of the following solution of this defect, which, evidently, is not due to a failure to coalesce, but is rather the result of a rupture of the enamel organ at this point, a separation of the ameloblastic layer, thus separating the rods and forming a fissure.

At the period of development, when this rupture takes place, the pulp has assumed the form of the future tooth, but not its full size. Small caps of dentine are formed over the points of the cusps; the enamel organ developing, the pulp has undergone a change noticeable in the form of the cells, and a change is taking place, noticed by Mr. Tomes and others, namely, changing from protoplasm to form material ready to receive the lime-salts. This change commences at points directly over the points of the cusps and passes gradually out from these points, as centers, towards the center of the grinding surface, and down towards the sides of the crown. This change renders the cells stiff and unyielding. The growth of the pulp stretches the investing enamel organ, and the points over the cusps being fixed the strain comes directly on the softest and most yielding portion, midway between the cusps, where fissures are to be found. The strain upon the enamel sheet separates the ameloblasts, and thus a break in their continuity is formed, which is not repaired, and a consequent fissure is formed in the sheet of enamel. The term coalition implies the union of two separate portions which are independent of each other; but we have seen that the enamel grows from a continuous sheet of ameloblasts, each connected with the other, so that here there can be no failure to coalesce. It is true that the deposit of lime-salts takes place from certain points, but the receptacles for the lime envelop the entire crown. These fissures are most frequently found on teeth having prominent cusps, as in such cases the enamel organ is most subject to rupture. These cracks or fissures which, before the eruption of the tooth, present smooth walls of enamel rods, soon after eruption become discolored and filled with debris and leptothrix, and

assume the appearance as seen under the microscope and described by Wedl. This defect in the enamel is of the same origin as the form described as pits—the absence of the ameloblast differing only in the cause; and most of the defects of this character, no matter what forms they may assume or where located, have this origin in which special constitutional disturbances play no part.

Of the second class of cases of defective enamel, the non-congenital or accidental as was suggested in my paper of last year, I believe a large number to be due to the abnormal action of the so-called absorbent organ. At the time when some of these defects occur the temporary teeth occupy their sockets in the alveoli; the permanent teeth are inclosed in the follicular wall, surrounded by a long crypt, which, with the roots of the temporary teeth, must be removed to allow them to assume their position in the arch. Nature has provided an agent to do this work. Mr. Tomes designates it as the absorbent organ, composed of a peculiar class of cells resembling the myeloid cells of Kölliker. Wedl designates these cells as osteo or odontoclasts. We believe them to be simply granulation cells. This organ, whatever it may be, is found in close contact with the tissue about to be removed, whether bone or tooth. Cup-shaped excavations filled with this cellular organ are noticeable on the surfaces being acted upon. The removal of the roots of the temporary teeth and the opening of the crypts for the eruption of the permanent teeth is said to be a physiological process, and yet it is so nearly allied in all physical characteristics to the other processes, termed pathological, that it is difficult to distinguish between them, so as to be able to say what characteristics mark a physiological, and what a pathological process.

We are of the opinion that the processes are identical, differing only in the circumstances producing them. Again, it is stated that the method employed by nature for the removal of the temporary teeth is *sui-generis*. We must dissent from this view, believing it to be the same process that she has provided for the removal of other tissues. The removal of the protruding stump of a limb, by the granulating cells, after the sloughing off of the soft parts, is identical in form and results with the removal of the temporary teeth. It is simply a result following one of the phases of inflammation: the result of an excitation in a part, otherwise

normal, inducing a proliferation of cell growth, which may be progressive or retrogressive in character, or both interchangeably; at one time acting as an absorbing organ, and at another as a builder up of tissue, dependent, as is generally supposed, on the amount of life-force present.

Let us apply this view of the character and action of the so-called absorbent organ to the removal of the roots of the temporary teeth. When the crown of a permanent tooth is completed and the growth of the tooth commences (if the process goes on normally), the growth of the root forces the crown onward against the hard tissue, covering it with force sufficient to produce excitation and a proliferation of cell growth in the part; and these cells, so far as we are able to learn, are identical in character with those found in a granulating wound and produced under similar conditions, the same as are produced in cases of inflammation of a low type, which results in destruction of tissue.

Here then we find the development of the absorbent cells in the part ready to remove any obstruction to the continued growth of the permanent tooth. Thus is the crypt of the permanent tooth, the alveolus and roots of the temporary tooth removed. It frequently happens that the partial removal of the temporary root is sufficient to relieve the pressure produced by the incoming tooth, changing the cells proliferated from a retrogressive to a progressive character; and the process of building up of tissue succeeds—and this again may be succeeded by absorption.

It is a noticeable fact that the roots of replanted teeth are frequently removed by a process identical, in all respects, to the removal of the temporary teeth. This occurs, in some cases, soon after the operation of replantation; in other cases several years may elapse before the tooth is lost. Sometimes this work of removal commences at the apex of the root, at other times it will be noticed at the gingival border.

The removal, by nature, of the roots of replanted teeth is termed a pathological process; and yet wherein does it differ from the removal of the roots of the temporary teeth, which is recognized as a physiological process? It is, undoubtedly, one and the same process, dependent on the same causes for its action, and governed and controlled by the same laws. The conditions in the case of a

replanted tooth are eminently fitted to induce this change, causing a proliferation of cell growth; the circulation in the parts surrounding the root being defective a low type of inflammation is readily set up, and the development of cells of a retrogressive character may reasonably be looked for, sooner or later, in every case.

Just how these cells do their work is as yet an unsettled question; most writers inclining to the opinion that a fluid of exudation is present which dissolves out the lime-salts from the hard tissues with which it comes in contact. The following brief extract, from a lecture by Dr. G. V. Black, Jacksonville, Ill., on "Ferments," is the best explanation of the action of the absorbent organ, and is, in my opinion, in advance of anything which has been written on this subject: "Absorptive and resorptive digestion is accomplished by a soluble ferment, elaborated by the tissues under special circumstances, for the removal of tissues no longer needed as roots of temporary teeth. The absorption of the temporary teeth is a physiological process, as all other absorptive processes are." It is brought about by the action of a class of cells which have become known as "osteo" or "odontoclasts." These are only the ordinary connective tissue cells of the part in immediate proximity with the part to be removed, which have temporarily taken on new functions—the secretion or elaboration of a soluble ferment for the removal of these roots of the temporary teeth which are no longer wanted. These cells perform this act in an indirect manner. It is plain that these roots are not removed by any mere mechanical force. These cells have no physical power of growing into them; they secrete a soluble ferment, analogous to the body which digests them, breaks them down and fits their substance for entering into the blood streams by osmosis, just as solid ingesta in the stomach is broken down and *fitted* to enter the circulation by osmosis.

There seems to be no foundation for the notion that the resorption of these roots may not form proper pabulum for the building up of other tissues; that the absorbed product is necessarily excreted. From accident or decay the temporary teeth often lose their pulps, which often results in the formation of an alveolar abscess, if such an abscess existed at the time absorption took place; if such absorption fails, partially or entirely, the tissue

which performs this function is thrown into a pathological state or condition, and the secretion of the soluble ferment does not take place in the usual manner.

If, however, the abscess does not occur, or if such abscess be cured and the tissues in immediate proximity to the devitalized root be perfectly healthy, it is found that the absorption goes on in the usual manner. The nerve death of the root does not interfere with the resorption, provided the physiological condition is maintained in the immediately surrounding cells, which are the active agents in the work. The soluble ferment does not depend for its action upon the life of the tissue to be acted upon. The roots are simply digested and enter the blood streams by osmosis, as any other digested material.

Many of the forms of honey-combed and furrowed teeth (incisors and sixth-year molars) closely resemble, in general appearance, surfaces of hard tissue which have been acted upon by the absorbent organ; incisors, marked by horizontal ridges, and furrows are said to have their origin in some constitutional defect, causing an arrest of development in the epithelial structure—the furrows indicating a period of arrest, the ridges a period of development, thus forcing the conclusion that there has been a succession of disturbances equal in number to the markings on the teeth. This can hardly be accepted as true, especially in cases where no constitutional disturbance has been observed. May not much of this marking on the incisors and sixth-year molars be due to the action of the absorbent cells? Is it not possible that, having performed their work of removing the temporary teeth and the alveoli, they continue to act and remove the enamel cuticle and dissolve out the lime from the freshly amelified enamel rods with which they come in immediate contact at the gingival border?

The succession of furrows observed may be accounted for by assuming that there is a period of growth and a period of rest for the incoming tooth; the cells, acting upon the enamel when the tooth is at a period of rest, form a furrow or groove across the surface. When the period of growth sets in the tooth shoots onward, and a portion of unaffected perfect enamel passes beyond the reach of their influence, forming a ridge; again a period of rest sets in, and again the cells act upon the enamel brought in immediate contact, and another furrow is formed; thus any

number of furrows and ridges are formed, dependent upon the continuance of the abnormal action of these cells. As this action is due to systemic conditions, all teeth in contact with the organ at the time are alike acted upon; hence the relative position of the markings on the incisors and canine teeth.

The sixth-year molar is acted upon in a similar manner by the organ which lies directly over and in contact with the grinding surface. The surface presents a series of pits and cup-shaped excavations, reaching, at some points, the dentine beneath. Spines of perfect unaffected enamel, the full depth of this tissue at this point, are frequently seen surrounded by these pits and excavations; the change noticeable in color, and the rounding up of the otherwise sharply outlined borders of these excavations, is due to subsequent action. The cases known as erosion, occurring at the gingival border, is, in many cases, undoubtedly the result of this same action of the granulation cells. What the conditions are which contribute to this abnormal action are, as yet, a hidden mystery. Like many other afflictions to which flesh is heir, we know not the cause thereof.

Touching the action of these cells, I quote another paragraph from Dr. Black's lecture on "Ferments," which may, in somewise, tend to clear our minds on this subject: "We have reason to suspect, at least, that soluble ferments are often found in places where they are not wanted. Tissues are stimulated to false secretions by various irritants and in many ways."

It is probable that many of the excoriating secretions, often met with in children, are soluble ferments given out through some mal-condition of the tissues. We have reason to suspect that, in some, decay of the tooth may come about in this way. We have already seen that tooth substance is digested and removed by a soluble ferment normally formed; the same is possible in an abnormal way. We have often noticed a peculiar irritated condition of the gums about the necks of the teeth, especially the inferior incisors; and the decay occurs in these portions exposed to the secretions thrown out. Twelve years ago, long before the conception of the ideas inculcated in this paper, we called attention to the connection between this irritation and decay in a paper before this society. Irritation from a clasp plate forms cavities for lodgment of colonies of bacteria.

Drs. Underwood and Miles of London, claim to have found a form of growth in the mouth which grew directly into the surface of the teeth, otherwise perfect. Dr. Miller of Berlin, seems non-plussed by the fact that he finds the softening of dentine in caries always in advance of the organisms. This is exactly what we should expect to find; for if decay is produced by the organisms, it must be by the digestive fluid, soluble ferments thrown out by them, or by their waste of products. When Dr. Koch was examining the gangrene produced in mice by the coco-bacterium of hospital gangrene, he found uniformly that the tissues were destroyed in advance of the bacteria. The bacteria seemed not to touch the living tissues at any time after the work was fairly begun, the tissues being destroyed in advance by the soluble ferment.

DISCUSSION.

Opened by DR. L. C. INGERSOLL of Keokuk, Iowa:

The subject presented by Professor Eames in his very able and excellent paper is too large to be entirely compassed in a discussion on an occasion like this. I can, therefore, but barely allude to several of his points, and pass on to the discussion of the main question, to account for the appearance of horizontal grooves and lines of pits on the labial, and sometimes on the lingual faces of the teeth also—including those cases where a succession of parallel grooves appear. Imperfect development of enamel, appearing in single spots, pits or wells in various locations on the teeth, I am willing to concede to congenital or pre-natal causes; for by the death or atrophy of a single cell, or a group of enamel cells, imperfect enamel would result. I shall not deny that suspended development may occur in the organs of tooth development, as in various other organs and tissues of the body—dwarfed limbs, missing toes, fingers, bones and teeth and other deformities are ample proof of this.

Dr. Eames is ingenious in his theory, and, in accordance with it, is able to account for some of the phenomena in question. But I do not see how he can account for the markings on first molars and bicuspids, nor for all the peculiarities of defect appearing in the enamel of the incisors. My object, however, is

not so much to oppose him as to oppose the commonly accepted theory, and to establish another which, in my judgment, will sufficiently account for all observed cases. In this we agree, that the old theory is wrong; and I am glad to find so efficient a helper as Professor Eames in the overthrow of a theory so universally held by the profession, supported by the teachings of all our dental literature for more than a hundred years. Yet I am constrained to say that I have no idea that the repeated announcement of and acquiescence in the theory, as announced by Bourdet in 1757, is the result of repeated investigations and demonstrations of its truth. But when the theory of arrested development was once announced, the authority of the man, without demonstration, was sufficient to give it credence. So great was its plausibility that demonstration was not demanded, and in the absence of all other ætiological account concerning it, the theory of suspended development has met with universal acceptance, although to-day it remains, so far as I know, without a single valid argument to support it. The flimsiest evidence of its truth has been received as valid. Let us look at some of these so-called evidences. It is said that the teeth, hair, and nails, having the same histological origin, each alike, shows, at least in some cases, the effect of the suspended development so apparent in the teeth, and, at the same time, a brief consideration will show the falsity of such assumptions. It is estimated that the life of nail cells is from four to five months, being less in summer than in winter. The nails being of perpetual growth, all markings of any sort on the nails would be obliterated in a period of a few months. How is it possible, then, that three years after the time when the teeth first exhibit their markings similar markings can be seen on the nails?

How is it, now, about the markings on the hair? Somebody in the long past, looking through his microscope, saw the imbricated condition of the surface, and at once pronounced it a case of suspended development, the same as appears on the teeth. If he had examined the hairs from a hundred heads, and from the bodies of the domestic animals, he would have found the evidence of measles or small-pox in every case. The structure of the human hair, as modern histological science gives it to us, is thus: [Blackboard illustration.] The hair of the cat is represented as

a series of truncated cones, thus: [Blackboard illustration.] This imbricated condition, like the overlaping of shingles on a roof, is supposed to represent a period of suspended development.

About forty years ago there was published in New York a small work, giving an account of the formation and development of the teeth, and of various diseases to which they are subject. In this work the author introduces another illustration of suspended development, with results similar to those found on the teeth. The case was that of the cow's horn. He found it with alternating ridges and grooves, which he pronounced the result of faulty nutrition and arrested development. This went, so far as I know, as unquestioned an illustration as nails and hair. Suppose some doubter had ventured to ask the author, "How is it that these ridges and grooves never appear till after the animal is three years old?" The only wise answer he could have given and supported his theory would have been, that bovines never *suspend* till after they are three years old. Let us now, for a moment, look at the structure of a horn. Its corneous layers are also imbricated. Up to the third year the outer layer is continuous, from the tip to the skull. During the fourth year it runs out at the surface, and underneath its terminal edge is seen another layer. And thus, each succeeding year, is brought to view the terminal edge of one of the layers, and between these terminal edges is presented, from year to year, an additional groove.

The strongest and most reliable argument of all is of a historical character—"the mother of the child told me so." It is alleged that, in a large number of cases, in regard to which investigation has been made, the mothers and nurses have confirmed the theory of the investigator that, at the period when certain teeth were receiving their amelification, the child was afflicted with a severe constitutional disease.

You may fix any period during the first five years of the child's life—the years in which the teeth are in the process of amelification—and ask the mother, "Did not your child, at that time or during that year, have some constitutional disease?" and she will be compelled, in nearly every instance, to say "yes;" and that, too, not alone of the child whose teeth are pitted or otherwise marked, but of every child of her's. For see the long list of diseases to which children are subject at that period of life: Measles, whooping

cough, eclampsia, scarlatina, eruptive fever, gastric fever, scalled head and a long list of exanthematous diseases. With this long catalogue of diseases on the tapis of childhood, it is scarcely possible for an enfeebled child to pass a single year and escape all. Hence, any mother could truthfully respond in the affirmative as to the happening of some constitutional disease during any assumed period that a professional man might name. I say *assumed* period; for with the known variation in the time of development of the teeth of different children, all is guess-work as to the particular stage of development of any child's teeth before they have emerged from the gum. Yet we are told by the wisest men of our land, and of all lands in the science of dentology, that these markings on the teeth enable the dentist to tell, with considerable accuracy, the period when there was some constitutional disturbance. This is the same kind of accuracy with which Prof. Tice predicted the weather. Turn over the pages of his almanac and you will find, at some specified date, "*Rain in places.*" So, if there is rain on that day anywhere on the face of the earth, he evokes all his thermal wisdom and astronomical science to declare that there must have been, at that time, "some *ærial* disturbance;" and when there is any ærial disturbance, there may be rain in places.

Now, how is it as to the testimony of mothers concerning the new doctrine, that these markings on the enamel occur *after* the teeth have cut the gum, and are brought about by chemical decomposition? *All* the diseases incident to childhood do not occur previous to five years of age. Several of the diseases named are quite as common an affliction between the ages of five and ten as between one and five. I have often asked mothers, when I have been consulted concerning this peculiar condition of the teeth of their children, Did not your child, at the time when these teeth were emerging, have some severe disease which involved the mucous membrane of the mouth? And I invariably get an affirmative answer. Thus far the testimony on both sides is equal, and therefore no proof of *either* theory.

Should I now get the testimony of observation and demonstration—which is not possible, or, if possible, has never been attempted concerning the old theory, but which is possible, and has actually been obtained concerning the new theory—according to the amount of this testimony the new theory is established. [A case related.]

Now let us scrutinize the accepted theory a little more closely. It is this, that at an early period in life, while the enamel is in process of formation, a line of enamel cells, extending horizontally along the labial portion of the tooth, and, in some cases, completely encircling the crown, suspend the process of amelification, which is plainly marked on the fully emerged crown by a groove or by irregularly formed pits at intervals in the same line.

The deposit of enamel, as has been stated by Prof. Eames in his former paper, is in one continuous sheet over the entire cap of dentine. Why then should there be suspension only in a particular line of cells running horizontally? Why not just as often running vertically? Or why not a suspension of the developmental work of all the ameloblasts of the enamel organ? Still further, why should we not expect to find the odontoblasts as well as the ameloblasts affected in a similar manner, and thus find a groove or rather a hollow tube, as it must necessarily be, in the solid dentine entirely encircling the crown in some instances, opposite the groove on the enamel? Why are the markings sometimes on the labial faces and not on the lingual? Now, let us for a moment look at the most puzzling of all questions pertaining to the accepted theory, and that is to account for the appearance of *parallel* grooves at regular intervals, numbering, in some cases, five or six. The reasons sometimes offered are ludicrous, and if carried out to the full limit of their application they appear ridiculous in the extreme. One author, to whom I have alluded, introducing a goose quill for illustration—a quill having rings around the barrel of the quill, constricting it, at intervals as though threads had been tied around it and checked its filling out at these points to its full size—says that these rings, indicating suspended nutrition and development, were probably caused by irregular feeding. At one time the farmer's corn gave out, and the goose almost starved; then again the fowl would have a full supply, and become sick and lose its appetite from over-feeding, which would result in another ring. Then, in accounting for the alternate rings and grooves on a cow's horn, he says they indicate the change of nutrition on the recurrence of summer and winter. In the summer the animal is fat and sleek and well nourished, and the whole body develops symmetrically; but in winter the animal's food is changed—has no relish for the dry food, and perhaps is poorly sheltered and cared

for, and this causes a suspended development in the horns, and probably in the hoofs too.

Now, what does the dentist say concerning the teeth? In accordance with the accepted theory he says: at this point of amelification the child had scarlatina; at that point whooping cough, when another groove was formed; at the next point small pox; at the next point eclampsia; and so on, through the list of constitutional ailments of children that interrupt nutrition. And where it is observed that these grooves occur, in some cases, at regular distances from each other, all that he can say, in accounting for it, is that the child began with fits, and in exactly two months after he had an eruption fever; and in exactly two months after that he had small pox; and at regular intervals thereafter he had some other exanthematous disease, and wound up with a relapse of all he had gone through with before, which produced a suspension of development and a loss of enamel over a wide area. If there is anywhere to be found in ætiology anything more ridiculous than this, I should like to have it shown.

Now, if it is possible for you to disabuse your minds of so erroneous a theory, after cherishing it long, you will be prepared to consider another theory and to mark its coincidence with well-known facts. The statement of the new theory is this, that these markings do not occur during the follicular development, but are the result of chemical action, occurring after the development of the crown and after its emergence through the gum. The fact of the erosion of the enamel at the margin of the gum, in the form of a groove, is one of universal observation. It may be considered an accepted fact that a horizontal groove or line may thus be produced along the labial or buccal face of a tooth, and also, as sometimes seen, on the lingual faces. This dissolving of the enamel, in a horizontal line at the margin of the gum, may occur at any period during the emergence of the crown—at the time when the point of a cuspid has just made its appearance, or when half the crown is seen; in the latter case the marking will appear on the fully developed tooth, midway between the point of the cusp and the margin of the gum. The case is not now fully explained until we account for the appearance, at regular intervals, of grooves alternating with ridges.

I saw this difficulty some years ago, in attempting to establish the theory, and discovered, as I think, a full explanation in the physiological law that governs both plant and animal development, and that is the law of alternate vital action; in other words, that *active* development alternates with *arrested* development. Illustrations are both ample and evident throughout the body, and are apparent everywhere in animate nature. Look out now upon the maples, and you will see a case of suspended development; the leaf buds of last year have fully unfolded; the leaf has expanded to its full size; you will see no more development at the top of the tree, possibly, for two or three weeks. It has suspended development at the ends of the branches, and is developing in some other part of the tree. After a period of arrested development at the top, you will see a renewal of development and the tree will be covered with a fresh growth of light colored, yellowish-green foliage. Look at the peach tree, to which I cannot point you this year, and when the petals of its blossom fall, the fruit germ will, in two or three days, have gained the size of a pea, and soon after that of a cherry, and rapidly reach the size of a robin's egg, then suspend, and make no more increase in size for weeks. But this whole tree does not suspend; it is developing in some other part, the stone which was before pulpy is now hardening; each part alternates with some other part.

Arrested development may, therefore, be shown to be a physiological law, and as such to prove the fallacy of assuming that arrested development implies constitutional disease and impairment of tissue. Because, under the physiological law, when the development processes are for a while suspended, the tissues do not suffer impairment by reason of the suspension. Nature takes up the work where she left off, and the tissue is perfect throughout. Every part of the human body has its alternating part—the brain alternates in its development with the cranium; the intestinal canal with the abdominal walls; the teeth with the surrounding tissue, the alveolar walls; the ameloblasts with the odontoblasts,—they are counterparts of each other. The working out of this law is one of the economics of nature. The elements of bodily growth are obtained through the nutrient system. If it was required that all parts of the body should develop uniformly and at the same time, it would be impossible for the

nutrient system to supply all the elements. If all the hard tissue of the body developed equally, in the same period of time, it would be an utter impossibility, in the nature of things, to obtain in food the amount of lime-salts which would be required. This fact shows the economy of nature in the law of alternate vital action. Were there never any functional disturbances caused by disease, the body would develop under this law in the same perfect symmetry as we might presume that it would under a system of uniform and uninterrupted development. This law of alternate development explains the incomplete formation of tissue, in cases of congenital hernia. In the alteration between the intestinal canal and the abdominal walls, the functions employed in the development of the latter did not keep pace with the intestinal development, caused by some functional weakness at the period when development should have been normally active in the abdominal tissue. We are often called to observe the want of harmony between the teeth and the jaws—the teeth are too large for the jaws, or the jaws are too large for the teeth. This occurs because, at the period when the vital forces were employed in the development of the one or the other of these tissues, either there was a deficiency in the supply of lime-salts or a deficiency in the power of assimilation.

Now, we are prepared to consider the alternation of grooves and ridges on the teeth. It must have been observed by some of you, at least, that investigators, concerning different organs of the body, have found it not only convenient, but necessary, so far as their observations concerning the teeth are concerned, if they would note decided changes and progress, to make their observations bi-monthly. This circumstance points to the fact that their alternating period of development returns about once in two months. This conforms, also, to the periods laid down in our books, as usually observed concerning the emergence of the teeth: a new tooth appearing about once in two months; the centrals of the deciduous set at about the seventh month; laterals at about the ninth month; then the molars appearing successively in the 24th, 26th, 28th, and 30th months. This bi-monthly development pertains not simply to the period of cutting, but also to the periods of progress, on to the full development and normal position of the teeth in the jaws. Now, we are in

possession of all the facts, individually considered, and necessary to the production of the peculiar pathological condition under consideration: *First fact*—an acrid fluid developed at the margins of the gum which, in its nascent state, is an active solvent of enamel; *Second fact*—a *periodic* active development of the teeth, during which the tooth rapidly emerges, alternating with a periodic cessation of development, during which the tooth crown does not advance. The first fact may be the result of gastritis or a general febrile condition, whether associated with exanthematous disease or not. A diagnosis need not go beyond the inflammation of the mucous tissue of the mouth. Suppose, now, this occurs at the developmental period of from five to ten years of age, and is active at the alternating period of cessation of development, a horizontal groove must inevitably be the result. This period of cessation is followed, according to a law of nature, by a period of rapid development and emergence of the tooth crown from the gum. During this period there is no portion of the enamel sufficiently long in contact with the margin of the gum, where this erosive agent is working, to seriously affect the enamel. But if the diseased condition remains for several months through a summer season, as it sometimes does, when the next periodic cessation of development occurs, whether it is in exactly two months or three months, it matters not; at that period another groove will be formed, and the number of the grooves will correspond with the number of periods when there was a cessation of advance of the tooth towards the full exposure of the crown.

DR. BLACK: My friend from Iowa seems to have gone astray —become a confirmed skeptic on this whole subject. I must object to his sweeping departure from, and condemnation of, the older views. For years past I have had this matter under pretty close observation. It has been this observation that produced the chart we have now before us. Take the case of the so-called Hutchinson tooth: one of the three points of the cutting-edge has atrophied—not simply failed to develop, nor dissolved away after the formation of the organ. We have a veritable cicatrix; and this cicatrix was formed before the calcification of the hard structures immediately surrounding it. We know this from the fact that the hard structures, both enamel and dentine, are conformed to the cicatrix;

this rounded, conical form has not been produced by the dissolving away of its surface; it is not a question of defective enamel only: the dentine that was in process of formation at the time the defect must have occurred is faulty also. This is not only true of this individual tooth, but of every tooth in the mouth that was in process of formation at that time. I have searched this out in so many cases that I feel that I cannot be mistaken about it. Then, if I have observed rightly on these points, this scar, and the faulty enamel and dentine in this and other teeth in the same mouth, mark a period of imperfect nutrition. And if several markings occur on the same tooth, they refer to so many periods of depression. As to the cause of this failure, I suppose that it may come from anything which produces a marked effect on the nutritive powers. They are not from any particular disease, but may occur from want of food, syphilis, measles, scarlet fever, and other disturbances of nutrition. The falling off of the hair, as a result of typhoid fever, is of the same order of phenomena. A certain part of the hair is faulty from the failure of nutrition, and after this part comes through the surface the hair breaks away. It does not follow, however, that there are no faults but those that occur from faulty nutrition. Faults that cannot be assigned to that cause crop out occasionally. It may be that the theory of Dr. Eames will serve to explain some of these and give us light on points that have been very obscure.

DR. INGERSOLL: Is there any reason why the lines should be only parallel?

DR. BLACK: The lines of development are horizontal, and parallel upon the individual teeth, but vary in hight from tooth to tooth; and we find these faults following accurately the lines of contemporaneous development, not only on the individual teeth, but from tooth to tooth. This is another proof that these faults are a result of arrested development.

DR. INGERSOLL: Why do we not find lines and grooves on the roots of the teeth as well?

DR. BLACK: We do find them, if we look for them. It is true that these faults occur much oftener in the epithelial structures than in other formations; yet the corresponding lines of defective structure may often be found in the dentine and cementum of the

root, where teeth that are later in their development show it on the enamel.

DR. JUDD: Our difficulty in the study of this subject is the lack of data. It is a question with me if the dentine is not always affected. I rather think it is. The groove may be formed by arrested development in the dentine alone, causing a depression on the external surface of the enamel.

INFLAMMATION.

BY HOMER JUDD, M. D., OF ALTON, ILL.

"The premature extinction of life," says Watson, in his Practice of Physic, "is more often owing to the agency, immediate or remote, of that process which we call inflammation than to any other morbid condition whatever." The study of medicine has, therefore, from its earliest history to the present time, been, to a very great extent, the study of inflammatory conditions. We propose to collect a few of the most important facts which have been learned relating to the inflammatory process, and also to make mention of some of the problems which have arisen during the discussions and investigations which have taken place upon this subject, and which are, as yet, unsolved. We are fearful that the latter will prove to be the longer category. The few cardinal symptoms of inflammation, which were first formulated by Celsus, are so well known by every member of this society that it will not be necessary to even mention them in this connection. It will be proper, however, to remark that all of these symptoms are by no means present in every inflammatory affection. In fact, no one of them is invariably present in every inflammation, though some of them are always present in every inflammatory condition.

Stricker, in his elaborate article upon inflammation in the "Encyclopedia of Surgery," states that to the four cardinal symptoms of inflammation has been added "impaired function." But what is a symptom of disease? Dungleson says a symptom is any change which is perceptible to the senses in any organ or function which is connected with morbific influence. Webster's

definition is "a perceptible change in the body or its function, which indicates disease." "Error of nutrition" is a favorite expression of others of the modern school of medicine, who claim that it is a constant symptom in inflammatory affections. But impaired function or error of nutrition, is, by no means, characteristic of inflammatory disease, inasmuch as they are just as constantly present in many other affections. It seems as if this new symptom—for these two cover essentially the same ground—had been tacked on to the category proposed by Celsus for the purpose of vindicating the progressive course of medical science. Writers are not infrequently over-anxious to produce something in advance of the old doctrines in their dissertations, and consequently we find many things written, even by those who are usually instructive, that had much better been left out. Now, these symptoms, which can scarcely be recognized in many cases by the senses at all, and, consequently, can hardly be called symptoms of anything, according to the definitions quoted above, are just as much symptoms of typhoid fever, measles, small pox, dyspepsia or whooping cough, as of inflammatory action. But if this new so-called symptom of inflammation was really pathognomonic of the inflammatory process, how much would its use, in this connection, add to our clear conception of inflammation, when the difficulty of discovering the symptom would be, in most cases, much greater than that of diagnosing the disease, without reference to this symptom at all. It will be observed that these expressions, "impaired function" and "error of nutrition," are exceedingly broad, covering all the ground on both sides of normal action, so that they cannot be assailed by any determined facts of observation; especially as, in case of experimentation, these actions could not be compared with any known data, because no one could know exactly, in any given case, what the precise normal action would be; at the same time we would not deny but that, during long continued inflammations, as well as in all other long continued affections, functional disturbances and errors of nutrition are sufficiently evident, which fact was doubtless as well-known to Celsus and his contemporaries as to the observers of the present day.

But we desire to call attention to some other points discussed in Stricker's article, referred to before. That his new theory of inflammation is sufficiently radical to satisfy the most enthusiastic

seeker for new truths is evident without any prolonged examination of its new departures. His doctrine is formulated thus: "Metamorphosis of tissue, return to the embryonic condition, division into amæboid cells of the masses which have become movable, hence the destruction and the suppuration." Stricker repudiates the doctrine of Cohnheim in relation to the migration of leucocytes, and returns to Virchow's old idea in relation to the proliferation of the fixed cells of the connective tissues; claims that Cohnheim got his first idea about the migration of white blood corpuscles from experiments of Stricker himself, by which he proved that the red corpuscles of the blood could pass through the walls of the vessels, etc. So this whole doctrine of leucocyte migration, which was brought out by Cohnheim, and which has been endorsed by Virchow, Billroth, Rindfleisch. Von Recklinghausen, and almost universally by the most distinguished German, English and American observers, is demolished by one stroke of Stricker's pen, and our whole microscopic literature, as far as it relates to inflammation, must be re-written, if Stricker's views upon these subjects are correct. We do not propose to enter into any lengthy discussion of these somewhat extraordinary statements of Stricker's, but we cannot refrain from placing a few of these statements in such a light that their full bearing may be easily perceived. In this article Stricker states that, in the embryo, the entire organ consists of amæboid cells, or, as he would prefer to call it, amæboid substance. He also states that "as soon as an inflammation occurs the tissues return to their embryonic state;" that is, to the condition of amæboid cells or amæboid substance.

Again, he makes the statement that "in inflammation, the tissues are transposed into pus corpuscles;" therefore, embryonic amæboid cells or substance must, in the opinion of Stricker, be identical with pus corpuscles. Now, although there is a very great similarity existing between embryonic amæboid cells and pus corpuscles, as shown in the field of the microscope, the former is endowed with the potentiality of development into tissues and organs, whilst the latter is devoid of all such potentiality; the essential difference being, therefore, nearly as marked as that which separates living from non-living matter.

It is possible that the translation may not have done the author justice on this point; and we should have been inclined to

this view had it not been for many other statements made in an authoritative manner, without sufficient evidence, as it seems to me, to establish their reliabilty; reminding one of the extravagant expressions of doctrine in Hahnemann's Organon, rather than of the carefully studied productions of scientific men.

It is also stated, in this article to which we have referred, that the arteries, veins, and capillaries all actively contract and dilate under the control of two separate systems of vaso-motor nerves, which have their origin in the spinal column; though he admits that he does not understand the way in which these contractions and dilatations are brought about, but thinks the vessels contract and dilate as a whole, without any reference to muscular fibres in the walls of the vessels. He states that the distribution of these vaso-motor nerves has not been made out, but claims that their roots have been located as they emerge from the spinal column in company with other spinal nerves. Now, if these remarkable statements of Stricker should be found to be correct, we shall, hereafter, receive all doctrines, based upon microscopic observations, with a great deal of suspicion, as no doctrine has been more favorably received, by nearly all of the most distinguished microscopists in all lands, than Cohnheim's doctrine of inflammation, founded upon his discovery of leucocyte migration. We are confident that a great majority of the intelligent, cautious-thinking men of the medical profession still hold to the doctrine of Cohnheim.

The ancients were by no means wanting in the accuracy of their observations; but these were, of course, limited to a certain extent by the influence of many of the appliances and instruments which modern science has provided for the use of the observers of the day. When Celsus declared that redness and swelling with heat and pain were the cardinal symptoms of inflammations, his category of symptoms was so complete that it has traveled along down upon the tide of time, so that we find it with us to-day, universally acknowledged as covering all of the most important phenomena which are easily recognized during the inflammatory process. The old saying of "*ubi irritatio ibi affluxas,*" is discarded by no one at the present time. In the history of inflammation it was stated that, in the first place, there was irritation, and some modern writers have

endeavored to amend that statement, by substituting injury for irritation; but as the latter has been used in this connection for a long period of time, it is by no means certain that anything would be gained by such a change.

Following the irritation, it was stated that a contraction of the vessels took place, and, in consequence, an increase in the quantity of blood carried to the parts; that after a certain length of time the vessels dilated and the blood, which had before passed through the vessels with increased velocity, began to move more slowly, and finally stopped, and there was stasis or stagnation. Then, after a longer or shorter time, either resolution took place, or there was suppuration, or mortification, or gangrene; the particular result being determined by the intensity of the inflammatory action.

The contraction of vessels was supposed to be brought about by the contraction of circular muscular fibres in the middle coat of the vessels. The subsequent dilatation was supposed to be due to the exhaustion of the muscular contractility, together with the propulsive force of the heart. The increased flow of blood to the inflamed part was supposed to be due to the contraction of the vessels, but exactly how the contraction of the vessels could bring about that result was never clearly explained. By the aid of the microscope it was ascertained that dilatation of the vessels, in some cases, was present in a very short time after the application of the irritant to the part, and, finally, it was conceded that dilatation sometimes followed immediately after the irritant was applied. Some contended, however, that contraction always followed the irritation, but that its duration was so short that it could not be observed; but as this interfered with the doctrine of exhaustion of muscular contractility, in accounting for dilatation of the vessels, it was, necessarily, finally abandoned, as it was altogether too improbable to receive credence—that the irritability of a muscle would be completely exhausted by a contractile effort which was so short that it could not be observed.

The existence of vaso-motor nerves was sadly needed to explain some of the phenomena connected with contraction of the vessels; but the explanation of dilatation was a much more difficult problem to solve, and to the ordinary mind such a system was

powerless to explain the process of dilatation. Stricker, however, saw the difficulty, and came boldly to the rescue, when he propounded the theory of a double set of vaso-motors, one of which presided over the contraction and the other over the dilatation of the vessels. He has, in reality, cut the Gordian knot.

His theory seems to be broad enough to cover all the ground that was necessary to explain all of the old, unsolved questions in this immediate field of inquiry. He declares that arteries, veins and capillaries all actively contract and dilate in the same manner. This explains a good many difficult problems; and the only objection which can be urged against it is that we do not know that it is true, as several links in the chain of evidence are still wanting in order that the demonstration may be complete.

Then, again, Stricker's doctrine brings us face to face with another problem, which will have to be considered in connection with this subject, and which may prove as difficult of solution as any of those which Stricker's bold hypothesis was intended to explain. We refer to a system of contractile tissues which are under the control of the nervous system, and which do not contain muscular fibres; for he concedes that there are no muscular fibres in the capillary vessels, and also states that the small veins contain no circular muscular fibres; so he plainly states it as his opinion that these vessels contract and dilate, as a whole, without reference to muscular fibres of any kind. Having mentioned the principal doctrinal points, connected more or less closely with the cardinal symptoms, we will simply mention some of the symptoms which may be called constitutional. If an inflammation is of considerable extent, and continues for some time, we have inflammatory fever. Chilly sensations are succeeded by a hot, dry skin, parched tongue, a full and more rapid pulse, lassitude, pains in the back and limbs, with headache, thirst, disagreeable taste in the mouth, loss of appetite, furred tongue, etc. By the aid of the microscope we are enabled to observe some of the processes which take place within the tissues without difficulty.

By placing the web of a frog's foot under the field of a microscope the normal circulation of the blood, as it passes through the smaller arteries and spreads out into the capillary network, from which it is gathered up by the veins and passed back to the

heart, can be easily seen, and the whole process is carried on so plainly before our eyes that there is but little danger of making any serious mistakes in our observations. We clearly see the red corpuscles of the blood passing along in the center of the tubes, and one cannot fail to be impressed with the idea that there is a mutual repulsion between the walls of the vessels and the red corpuscles, since the latter never impinge upon the former, however tortuous the course of the vessel may be; whilst, on the other hand, the leucocytes or white corpuscles seem to creep along in direct contact with the walls of the vessels, so that it seems as if there was a mutual attraction between them and the walls of the vessels which contain them. If the parts are irritated, we at first notice an increase in the velocity of the blood as it passes along the vessels; and if the irritation is continued, the red corpuscles cease to retain their position in the center of the vessels, and not only impinge upon the walls of the vessels, but come in contact with each other and cling together in masses, and soon the blood streams begin to move more and more slowly, until the circulation through the part subjected to the greatest irritation ceases. Then we have stasis. The number of leucocytes, in the meantime, has greatly increased in the inflamed part, and there can be but little doubt but that then the leucocytes migrate through the walls of the vessels and pass into the surrounding tissues. These processes can all be easily observed by any one but little skilled in the use of the microscope, until that point is reached when the leucocytes pass through the walls of the vessels, when, on account of the necessity of special preparation of the specimen observed and the difficulty of keeping continuous watch at one point for the considerable period of time which is required for a leucocyte to make the passage through the wall of the vessel, the observation becomes much more difficult. When leucocytes collect together into a mass in the tissue to which they have wandered, we have a circumscribed abscess. How do corpuscular bodies pass through the walls of the vessels? Are there stomata in the walls through which they pass, or are the vessels constructed of a substance similar to protoplasm, which immediately closes up after a body passes through it, as water closes behind the keel of a boat as it passes along through its native element? What directs, and what force propels, the leucocytes in their wanderings? In what way does resolution take

place after stasis has once occurred? We have an abundance of hypotheses upon nearly all of these questions, but having all of the data which those who do our speculating have we can just as well speculate for ourselves as to make use of the speculations of others. In either case it is scarcely probable that anything will be gained by the speculations, whatever they may be.

The fact is, the age of speculation upon scientific subjects is past, and nothing but experimentation and demonstration will satisfy thinking men at the present time. Recent observations promise much in the way of explanation, as regards some of the unsolved problems connected with mortification, gangrene, pyæmia, septicæmia, erysipelas, etc.

Pasteur is confident that putrefaction of animal matter is brought about by a process of fermentation, which is always engendered by the vibrio-septica, a species of bacterium; and Koch declares that gangrene is, in a similar manner, produced by a certain micrococcus, and that different species of bacteria produce septicæmia, erysipelas, spreading abscess, etc., and he declares that he has demonstrated this to be true by three different kinds of bacteria. These doctrines must, of course, modify our views in relation to the results of inflammation, and, perhaps, we shall be obliged to restrict them to resolution, suppuration and tissue organization. As to the immediate causes of the cardinal symptoms there is but little difference of opinion among pathologists. The swelling is doubtless due to the exudation into the tissues from the vessels, together with the unusual distention of the blood vessels or congestion of the part. The redness is accounted for by the increased volume of the blood, and, in some cases, extravasation of red corpuscles and infiltration of the tissues with the coloring matter of the blood. The heat is due, to some little extent, to the increase in the quantity of the blood, but principally to the increased activity in the tissue metamorphoses, which take place in the inflamed part during the inflammatory action. John Hunter directed his attention particularly to this subject, and found that the local heat reached 107° Fahrenheit in some cases, but he expresses the opinion that the local heat is never greater than it is at the center of the circulatory system at the same time. This opinion, however, is not in accord with the views of modern observers, and it is pretty well established now that the local heat

in circumscribed inflammations is considerably greater than at the heart. The pain is doubtless due to the pressure, stretching and irritation of the nerves; the latter, perhaps, brought about by the sudden changes in the electrical conditions of the nervous trunks. If we should attempt to formulate the conditions, which we apprehend are always present where there is inflammation, we would state that there is, *first*, the irritation; *secondly*, there is obviously a change in the electrical conditions of the vascular walls and blood corpuscles, and then stasis. Without these we can scarcely imagine that there could be a veritable inflammation. The dividing line between irritation and inflammation has usually been arbitrarily fixed at stagnation, though some have, without any good reason, endeavored to substitute migration of leucocytes for stagnation. With these facts before the mind, one is in a position to formulate a practice which, to a certain extent, may be rational and philosophical. If it be in the irritation state, the irritant should of course be sought out, and, if possible, removed, in which case the irritation will soon subside and the normal condition be restored. If the electrical conditions have been disturbed to so great an extent that the corpuscles already begin to stick together, and also to the walls of the vessels, the removal of the primary cause of the irritation may suffice to restore the electrical equilibrium and lead to normal action. If stagnation has, to any considerable extent, taken place, something else will be required to relieve the congestion and restore the circulation. If the distended vessels of a congested part be contracted upon themselves, it is evident that the blood must be quickly expelled and the congestion, to a considerable extent, relieved. Though the infiltration in the tissues will not immediately disappear, if the vessels are relieved of their surplus fluid, they are then in a condition to enable them to absorb the surplus fluid from the surrounding tissues, so that the congestion will soon wholly disappear. Cold is a remedial agent, which, undoubtedly, stimulates the vessels to immediately contract; besides which it produces also what may be called a physical contraction upon living tissue, as well as upon non-living matter, and in the formation stage of an inflammation is, undoubtedly, one of our most potent remedies. The application of cold also, just at the time when the white corpuscles are creeping through the walls of the vessels, exercises, perhaps, a more powerful

influence in arresting the leucocyte migration than any other remedial agent at our command, unless, perhaps, it be the local abstraction of blood. It seems as if this migration only takes place, to any great extent, whilst there is a congestion of the vessels, and if the congestion is relieved the migration ceases.

Again, it is well known that cold exercises a very marked influence upon the amæboid movements of leucocytes in the way of restraining these motions, whilst it is equally well known that the application of heat stimulates these bodies to increased action. It seems to be the opinion of Rindfleisch that the leucocytes migrate by virtue of their independent powers of locomotion, and if this be true we may readily conclude that an agent like cold, which seems to partially, at least, paralyze amæboid bodies, would arrest their migratory movements. At a somewhat later stage in the inflammatory process Rindfleisch suggests the employment of heat, and philosophizes upon its use as follows: "We would only pass to the use of heat, when this indication, *i. e.*, the arrest of exudation has been fulfilled," etc. He then states that a certain amount of heat has a tendency to disperse the leucocytes, and to cause them to wander further, thus preventing them from collecting together with the consequent formation of abcess. He states, also, that a higher degree of heat increases the migration of the leucocytes from the vessels, and, therefore, its use might then bring about the very result which all of our efforts, up to this point, have endeavored to avert. But the use of moist heat is beneficial, also, in another way. When stagnation in the vessels is so firmly established that the congestion can only be removed by a disintegration of the cellular elements, the breaking down of these elements is effected, if effected at all, by fatty degeneration, by which they are converted into a "milk-like detritus," which can be readily absorbed and removed; and moist warmth is a most effective agent in bringing about the conditions upon which the fatty degeneration depends.

If by the use of these means we are fortunate enough to bring about resolution, our end will have been attained. But if resolution does not take place, and the leucocytes collect together and the formation of abscess be inevitable, moisture and warmth will hasten the process, whilst the application of cold, at this stage, would not

be advisable. The cellular infiltration is gathered together and the connective tissue of the part is melted, as it were, and dissolved, and in this destructive disintegration of tissue the leucocytes are also changed into pus corpuscles—changed from an element which is capable of proliferation and organization into tissue—into one in which no proliferation or organization into tissue is possible. Indeed, Rindfleisch rejects the doctrine which has been advocated by some, and which claims that pus corpuscles increase by proliferation.

But we find, also, cases in which the cellular infiltrate inclines to organization. Cirrhosis of the liver is a noted example of the result of inflammation. Chronic inflammations are much more liable to terminate in this way than acute; and in many cases, where new tissue is formed in this manner, remedial measures are of little avail. Although we have but just touched upon a few of the most prominent points that might be considered in connection with this subject, we feel as if we had already occupied as much time as ought to be taken up by one essayist, and therefore we will close, hoping that the few hints which we have thrown out will lead to useful consideration and discussion.

DISCUSSION.

DR. CROUSE: I would like to ask Dr. Judd concerning the inflammation theory of caries.

DR. JUDD: The definition of inflammation, given by Stricker, is, that it is a return of the inflamed tissue to the condition of amæboid tissue. If caries of teeth is an inflammatory process, this definition does not hold good.

DR. TAFT: The inflammation theory of caries is held and maintained by many. It is nonsense to think that tooth substance can return to its embryonal condition. I have no doubt there is a phase in caries when this condition is approximated in a slight degree. The champions of this theory differ among themselves, especially in their modes of expression.

DR. BLACK: There are few who can discuss the subject of inflammation with intelligence. I am proud to have this essay

appear in our transactions. In my opinion, there is nothing in the inflammation theory of caries.

Question—How can we have inflammation without blood vessels?

DR. BLACK: Inflammation is not dependent on blood vessels.

SPECIALISTS AND SPECIALTIES.

BY G. V. BLACK M. D., D.D.S., OF JACKSONVILLE, ILL.

This is an age of specialists and specialties. Everything is done by specialists, from the greatest undertaking to the smallest thing that is manufactured. The pins we use are made by the specialist; the clothes we wear are made by the specialist; the cloth these clothes are made from is made by the specialist, they are cut out by a specialist, and stitched together by the specialist: the thread with which they are stitched is made by the specialist, and the buttons are made by the specialist. Our watches are made by an army of specialists; each wheel, each pinion, each lever, each screw, the hands, the face, the case and forty other divisions of the watch is each made by a distinct specialist. Trees are cut, lumber is sawed and planed; houses are built, painted, and the roof is put on; each operation being done by a distinct specialist. If we buy a common lamp-burner, it has gone through the hands of at least a dozen specialists before it is ready for our use. Railroads are built by a specialist, through the agency of specialists, operated by an army of specialists. All the mechanical arts are divided and subdivided, as far as the ingenuity of man has been able to divide them.

How is it in the learned profession? Much the same. The tendency is to divide and subdivide everything into specialties, until every man must be a specialist, whether he will or not. A man who has no specialty is regarded with, to say the least, a suspicion of being nobody. No matter how well he may do many things, he must do some one thing especially well, if for nothing else,

to have a specialty. The healing of the sick must be done by the specialist, and each disease and organ of the body must have its own special specialist.

Then we have the legal specialists: the criminal lawyer, the real estate lawyer, the supreme court lawyer, the pettifogging lawyer, and a dozen other lawyers. Our people preach through specialists, sing through specialists and pray through specialists. There is nothing under the sun that is thought worthy of doing that is not done through specialists, from the grandest national undertaking to catching the mice that infest our closets.

Is this the nature of man? Is this process of specialization a natural trait of his intelligence? It seems to be; for in no age has this tendency been wholly hidden. Wherever we find traces of man we find some trace of this tendency. The tracings may be slight, yet they can be read in the oldest relics of prehistoric tribes that have yet been found on the earth. But in no age of the world, perhaps, has this tendency been carried to such extremes as in the present. We say perhaps, for from accounts it would seem that in the time of the splendor of ancient Egypt, specialties were forced to the greatest possible extremity. It was probably in that age and country that the greatest impress of the specialist was made on past history, and it has left its marks, which have existed through all ages down to the present time.

Without a systematized division of labor no such work as the pyramids and the great temples could have been built. Evidences of the specialist are found everywhere on the banks of the Nile, and it has been asserted that in Egypt this matter was carried to such extremes that the son was compelled, by public law, to follow the vocation of his father; that is, if the father was a dresser of stone, the son must also be a dresser of stone; if the father was a herdsman, the son must also be a herdsman; if the mother was a spinner of flax, the daughter must also be a spinner of flax; and so on through all the trades and professions of that time. Evidences of a similar division of labor can be traced through all the older civilizations, Phœnicia, Judea, Greece, Rome, and the Mohammedan civilizations, all along down to the present time.

At this time, however, we wish to call attention to the more recent forms of specialization that have sprung into existence,

mostly within the last century, largely as a result of the introduction of steam power, which has not only had a marked influence upon the mechanic arts of the world, but has impressed, and is giving form to the thought of the world.

In England, one hundred years ago, the labor of the country was very much specialized; but the specialization was of an entirely different order from the present. It was a specialization which was carried on largely in the family, in the home circle, under the direction of the head of the family. Work was done mostly by hand, or by small machines, scattered about in the homes of the people. Some families were perhaps employed in preparing the raw material and spinning, other families in weaving, another at this, another at that, all in their own homes. With the introduction of steam, these have been slowly gathered together in large factories, in which the one great central power, the steam engine, is so placed and harnessed about us to furnish power for all. These people are taken out of their homes and home influences, are ruled to specific hours of work; the division of labor is carried farther, and every year still farther; and each operator is ruled closer and closer to his, or her, specific task, under circumstances in which he knows less and less of what others are doing around him. Indeed, he is not expected to know anything but his own specific part of work upon which the whole number are engaged. The associations of the family are broken up and exchanged for that of the factory. This great change has been slowly in progress, in all departments of mechanics, for a century, and is still progressing, going farther and farther, as time goes on. This is the type of the tendency of specialization in the mechanic arts to-day; not only in the mechanic arts, but in everything; and the question comes home to us, To what will this lead, if this kind of specialization continues?

I have heard a story which will illustrate one feature of this tendency, even outside of the workshops proper. It is told of a farmer who wanted a man. A man was found, and the farmer wished to test him to see if he would answer his purpose. There was a pile of stones by the road side, so in the morning he told John to move the stones across the road; by noon John had them all moved. After dinner the farmer said, "John, you may move the

stones back, and pile them up where you found them." It was done without a word. The next morning John was told to move the stones across the road again, and after dinner to move them back again. All this time John had asked no questions as to all this useless work, and the farmer came to the conclusion that John would answer his purpose. He wanted simply a machine; a man who would do what he was told and ask no questions; a man that knew nothing, and wanted to know nothing. A manifestation of intelligence, or the desire for intelligence, would have been thought detrimental. This is now the tendency in a large class of the labor in all the great factories of the world. All work is done by machines. That which we have not yet been able to do by actual machines must be done by men who will consent to be made machines of; human machines, whose intelligence is depressed into the narrowest possible compass. That this plan works well from a financial standpoint there is not much doubt; but what will finally be the effect upon the men that do the work? They must become worse and worse, as time goes on. What can such men do, if financial depression or other circumstances should throw them out of their place? What will they be fit for? What can they be expected to do for themselves? Literally nothing. They become the prey of designing demagogues, become fit for riot and destruction of social order.

On the other hand this plan of work has developed some splendid minds among the master class. When we enter our modern watch factory and see the wonderful results which are drawn out by the use of machinery, controlled by uneducated girls and boys guided by the mind of the foreman, we must feel a thrill of pleasure in his success, and award to the plan of his work the merit of great skill in the adaptation of means to ends; a skill that, in the several mechanic arts, has cheapened almost every article in daily use, at the same time improving its quality.

Of course, we do not pretend that this picture covers the whole ground of the mechanic arts. In many of our large factories, especially those of the heavier sort of mechanics, as car building, locomotive building, ship building, and works of this nature, we find a very considerable number of highly intelligent operators among the men at the lathes, planers, etc., doing work that has not yet been so closely divided into specialties as to be done by

mere machines in human form; work that requires close thought and exact calculation, with a knowledge of the object to be accomplished. But even here the effort of the master is continually to so systematize and arrange the work into different pieces that it may be done by less intelligent men, and at a less cost in dollars and cents. Thus it goes on from year's end to year's end, systematizing and specializing, so that a few may think for the many, and the piece workers are continually increased, and the intelligent, thoughtful mechanics become fewer, and those few more highly intellectual as the years go by.

Now, we may ask, does this plan of work tend to the promotion of intelligence? The answer to this question will differ, with the standpoint from which it is given. If from a survey of the men and women employed at the piece work, it will, as we have already indicated, be averse to the development of intelligence. If it be from the standpoint of the master who thinks out and arranges the machines, and lays out the work for, and guides the workmen to the performance of their several tasks, we must award to this specialist a high degree of mental activity, calculated to promote true culture.

How is it with the learned professions? As we have said, they are divided and subdivided, until we have specialists of every form and variety. If this thing stopped with the laboring class, it would, probably, not lead to so much harm; for we must always have a great number of men who will never think for themselves, under the most favorable circumstances or surroundings in which they can be placed. Such men, perhaps, cannot do the world more good in any way other than by being controlled, and their labor thus utilized. But for the same state of things to exist in our professions, and among men who are supposed to think, not only for themselves but for others, becomes dangerous. But in the professions it is not exactly the same thing. In them men are not controlled by their superiors in knowledge, as in the arts they are controlled, virtually, by those who are superior financially; or, if so, it must be acknowledged, only to a very limited extent. We could almost wish they were; but, whether it will or not, the world must trust them, if at all, to think for themselves and those whom they serve. They are only controlled and guided, as they may choose to be controlled and guided, by more learned men

What do we mean by this? Perhaps we can illustrate: Some years ago one of the wisest men in the medical profession remarked that the improvements in the treatment of the diseases of the eye were in the hands of specialists, who, as a rule, confined themselves so closely to the one subject that their culture did not become broad enough to constitute them skillful investigators, and, for this reason, the subject was lagging behind. This, be it said to the credit of the medical profession, is now being remedied by the entrance of men of broad culture into this specialty. The tendency in the learned professions, where specialties are followed, is to become able to do one, or a few things, and repeat these over and over again by rote, like the girl in the watch factory, who, day after day, polishes the point of a certain pinion for hundreds of watches. What is true of the oculist, is true in every specialty of medicine. Those who practice them are extremely liable to become mere routine workers, who go on, from year to year, repeating the same thing, not only without definite advance, but with decreasing ability, oftentimes, to depart from their routine practice. In a more limited sense this is always true of any specialty, even of medicine as a whole. Hundreds of men cease all study, and go on, year after year, repeating the same prescriptions; doing nothing for the advance of their chosen branch of science.

Wherever we turn we are met with this narrowness in thought. It is not confined to the mechanic, who labors day after day at the vise, cutting a certain key-seat in a thousand shafts, each of which is peculiar to a certain place in as many machines. In every specialty in the learned professions, all over the world, the same routine work is being repeated. Is this because the men so employed are incapable of advancement? Would they be the same drones under other circumstances? It is hard to say; but one thing seems to be clear, the wider the field presented for study, the more the man is expanded, the broader he becomes and the more power he attains. I doubt if the world can show any example of a man truly great and powerful in any one line of thought, who was not, at the same time, a man of great breadth of thought, who had not also attained much information and sagacity in regard to things seemingly foreign to his specialty. In other words, our truly great men are never specialists in thought;

for though they may have followed out, elaborated and developed one special line of research, and unfolded it, and it only, to the world, in doing so their minds have traversed the whole realm of the conceivable, from center to circumference, and dragged out and massed together that which was necessary to their purpose, and woven it into one tangible, beautiful whole. The world of lookers-on may have seen them working in one field of labor, busily, steadily, persistently; but their world of thought was the whole world of intelligence.

Shall we then abolish the specialties, and demand that every man shall make the whole industry of man his field of labor? Certainly not. Though there may be many that are too narrow and might be dispensed with, with advantage, yet the world could not afford the sacrifice, which the destruction of the whole system of specialization would entail. How, then, shall we remedy the evil? Let every man be a specialist in labor, if he will, but in thought and study, cosmopolitan. In his specialty let him take views from every standpoint which the intelligence of the world will give him.

While passing down one of our rivers, a comrade said, "Beyond that bluff there is a beautiful valley, extending for many miles back into the country." I climbed the bluff to see the landscape. At the foot of the hill on the other side was a heavy wood, over the top of which I could see a long line of hills stretching away to the west, and through some breaks I caught the sparkle of some patches of the water of the little river that ran through the valley. But no beautiful view met my gaze. I felt but illy paid for climbing the high bluff. Across the little river to my right, a mile away, there was a higher bluff, the west slope of which was bare. I determined to try a view from it. When I reached its summit and turned my eyes in the direction of the valley, a most beautiful landscape met my view. The whole valley was spread out like a panorama before me, with its long lines of beautiful hills stretching away until partially veiled by azure; all covered with growing grain. In the wheat fields the harvesters were busy gathering in the golden harvest. The little river came winding down the valley, its bright waters sparkling in the late afternoon sun. From this point of view I counted a hundred wheat fields, in each of which there was a busy group of laborers

gathering their crops. I said to myself, to-morrow I will ramble through this land of beauty. The next day I went into the valley and wandered along its stream. I found it at one time rushing along a rocky bed, and again gathering into wide muddy flats. Its waters, which had looked so bright and beautiful from the distance in the evening's sun, were dull and muddy from the recent rains. The beautiful hills were many of them steep and stony; the soil was poor in quality, and the wheat was thin and short; the laborers were negroes, who were badly clothed, who lived in squalid huts with long bristled, sharp-nosed hogs and half starved curs. I wandered on, stumbling over stones and pulling through briers. I compared this land with the rich fields of Illinois, turned and retraced my steps, and left it.

Now, here are three views of the same thing from as many different standpoints. From the first, it was but partially seen, and it was neither beautiful nor repulsive; from the second, it was positively beautiful, a scene of which the eye would never tire; while from the third, we find it devoid of beauty, rocky, poor, and decidedly uninviting, The art specialist on the bluff would have called it grand, while another specialist, the Illinois farmer examining the land, would have turned away in disgust. So it is that the same thing is different when seen from different standpoints; and the man who views any subject from the most of these, and brings to his aid the greatest wealth of comparison, will know it best. The routine specialist who never changes his point of view does not even understand the outlines of his subject. He is like the man at the vise cutting key-seats, day after day, week after week, without a thought of the great world of intelligence around him, or what treasures it contains. It becomes the duty of each specialist to gather into his mind the widest range of knowledge possible. He should not be content with his primary education for the basis on which to build his specialty. The minister of the gospel of Christ should not be content with a knowledge of the bible and biblical history. Let him confine his visible labor to the pulpit, if he will, but the whole range of science, of philosophy, every avenue of intelligent activity should be his field of thought. It requires this to produce that broad expanse of mentality necessary to the best, most brilliant and effective handling of the subject of religion; a subject fraught with the most stupendous results, for good or evil to

the human family. Too close a confinement to the single subject in thought renders the man narrow in mind, over-confident, biased, saps his strength; it is liable to run him into error, and endangers those who depend upon his teachings. His power for good becomes much like that wonderful Scotchman's religion, who, basing his conclusion upon the fact that he could repeat the whole bible by rote, said he knew more about religion than any d——d devil of a preacher in the world.

The lawyer should know his forms of law, should know well the principles of law, and have a fair knowledge of the statutes, and the decisions of courts; but these alone will not constitute him a powerful lawyer. These are the tools with which he works; he must have the muscle with which to render these tools effective; and this figurative muscular strength he attains by increasing the breadth of his intelligence, by extending his knowledge of philosophy, of art, of science, and the doings of the world at large. In his visible labor he may confine himself to the bar, if he will, but his field of thought should spread to the four corners of the earth, if he would become great and powerful.

The dentist should know the forms of the teeth, should know well the anatomy of the face, should be conversant with physiology, and should understand the forms of disease with which he has to contend. But he should not be content with this; indeed, he may know all these things and still not be a capable dentist. He should not be satisfied with the study of those diseases alone, which fall within the limits of his specialty, but he should traverse, in his study, the whole range of pathology. He should not be content with physiology and the laws of life, as exhibited in the parts he is called upon to treat, but should gather from the whole range of biological science, and bring from all these fields the fruits of his findings for the improvement of his specialty. Then, as he does this, he should increase his strength and breadth of thought, by gathering from the general intelligence of the world at large, that he may have increased power for good.

We do not mean by this, that these specialists should be simple gatherers of the facts of the world, the bare facts of the arts, of philosophy, of religion, and of science; but that thoughtful search through the intelligence of the world, that mental grapple with the great surging sea of thought, which brings the mind face to

face with the great problems of human existence; that mental experience of human wants, human strivings and intelligence, which tunes the mind to the play of fact upon fact, and brings forth its power.

In this general struggle with the elements of thought, in its varying channels, it is not obligatory, or necessary, that every man should become an original investigator in all the lines of study which he may take up. The mechanic may seek new truths in mechanical powers and combinations; the electrician may unfold new facts in his particular field; the histologist may seek new paths through the maze of cell forms; or, the biologist may hew his way back down the rugged annals of time to the early beginnings of life on our planet; and all may unfold to the world the findings in their special fields, so that his neighbor may, with little expense of time, snatch up the findings of each, become master of the play of thought to which they give rise, and appropriate them to his use. For this purpose, no one mind can unerringly prescribe the course another should pursue; and it matters little what the hand may be doing if the mind be free and active, be always engaged, and kept in harmony with nature, and nature's God. The visible profession in life may be apparently narrow, yet the man may bring the knowledge of the whole world to bear upon it, or leave the mere work of the day far in the rear. How many instances of this kind are on record? Yet the fact stands out that, in the mass of instances the broader the visible field of work, the larger the man becomes. Why do we say this? Where do we find the greatest number of powerful men in the professions? Among the lawyers, if we mistake not; they are those whose fields have been the broadest the law can give. In the medical profession this is certainly true, and the disparity is so great that the specialties may fail to keep pace in their general advance with general medicine. If there are some apparent exceptions to this, as in the case of the specialty of surgery in the last century, it was because it attracted to it men that had been trained to thought in the mother profession.

What are we doing to-day in our chosen specialty? Here we are gathered together for comparison and exchange of thought. Each one is bringing the increment of his mental activity, attained during the year, to exchange with his associate in the work of

developing his specialty. What will each one do in the year that is to come? How many will go home and put into practice those findings of his fellow-laborers, which, after close and careful study of the point in all its bearings, he shall find better than his own? Or, again, how many of us will return to our chairs and go on through the year, repeating the old manipulations without change or a thought of a better way? How many books will be read among us per man? How many ideas, that seem new and useful, will be traced out by us with close and careful study of their relation to other ideas with which they may be naturally associated, and their value determined, and the whole matter put in shape for our meeting next year? Or how many of us will return home to a listless life of thoughtlessness, without a thought of the improvements that a little effort may bring him; not to him only, for the dentist is not working merely for self. The world of humanity are dependent upon his skill, upon his discernment, upon his intelligent application of the highest wisdom of his profession, for their personal good in important matters. And the world has the right to demand that he use the full strength of hand and brain.

DISCUSSION.

Opened by DR. GEORGE H. CUSHING:

Dr. Black, in his paper, has expressed much better than I could have done what I should have wished to say. In fact, he has stolen all my thunder! Still, there are a few points which it may be well to emphasize. It is the tendency, in all specialties, for men to run in grooves. This is a grave misfortune, and should be most earnestly combated. Without those comprehensive views that regard the individual organs as only parts of the whole system, each intimately associated with all the others, we cannot hope to attain that degree of excellence that can only belong to the true professional man.

Aside from this comprehensiveness, in a strictly professional sense, the true professional man should be as broad in his culture as his intellectual capacity will admit—for such breadth of culture is an immense aid to that breadth of professional view which, I have said, is so essential to the highest special training. The essayist in his paper gives evidence of this broader

culture. I do not say this in flattery, but because I could not have a better exemplification of the value of such culture than is furnished by his paper,—to you who know his professional life and labor and the results which he has achieved.

Of the past of Dental Education it may briefly be said that, in the main, it has been all that could, under the circumstances, have been expected. Of the present, that it is gradually coming up to the higher standard, so much to be desired; while of the future, we may confidently hope for the very highest results. For a few years late past there has been a growing demand for a higher education among dentists. This demand is imperative, and comes from the better understanding of the necessities for a more thorough qualification; and in response to that demand, which has found voice through the societies and journals, the colleges have very generally responded. The careful thinking men of the profession appreciate these necessities, and in their hands lies the shaping of our future, and I think we may safely say that the outlook is encouraging.

DR. TAFT: Dental association work is changing its form. Formerly, the character of the proceedings of societies was to study methods and modes of practice. The meetings were schools of instruction, where those who took part were instructors. The subject of *education* is the all important one now. It determines what the education of those who are to come after shall be. How those who are to constitute its ranks shall be prepared to practice our profession, depends on what *we* say or require. As regards preliminary education, the particulars in which we find ourselves deficient we must provide against in those who come after. Many who have not had these advantages have become great, but they are exceptions; and if they had enjoyed, also, the benefit of a liberal education, their influence would have been vastly greater.

The accumulation of facts and knowledge, and the training which enables one to use them, are the two essential points in acquiring an education. If a student has a good preliminary education, he can better utilize the advantages offered at college. Those who best master the special branches taught are most successful.

Because our nomenclature is derived from the dead languages and not anglicized, the one who has no knowledge of the classics studies at great disadvantage.

The rapid expansion of the curriculum in the last few years is remarkable. Histology has only recently been made a requirement. All knowledge should be made available; and every branch of science should be made the handmaid of our own profession.

We must guard well the avenues of entrance into the profession; complain not of the colleges; be careful who is encouraged to enter; see that they have some natural endowments. The profession is itself responsible for the kind of men who enter. It is a good augury that *many* students realize, at the end of their college course, that they are just beginning, as far as learning is concerned, and that some colleges are already agitating the question of providing post-graduate courses, to enable students to perfect themselves in weak points.

SOME APPLICATIONS OF ELECTROLYSIS IN DENTISTRY.

BY W. B. AMES D. D. S., OF CHICAGO.

A close study of the phenomena of the electric force and a varied application of it will give one an excellent adaption of means to ends. To supply one's-self with a galvanic or storage battery, and simply make use of it in exciting magnetism in one or two mechanical appliances is to ignore the most useful properties of this delicate force. The power of the galvanic current to decompose compound substances by its passage through them has been the foundation of many most useful discoveries, which have been variously applied in the arts during the last century. The chemical effects of statical electricity were first investigated by Drs. Priestly and Cavendish, in 1784. The decomposition of water, by passing through it a succession of discharges of statical electricity, was discovered in 1789 by several co-workers. The decomposition of water by the *galvanic current* was discovered and first

described by Nicholson and Carlyle, in 1800. On November 20th, 1806, Sir Humphrey Davy presented to the Royal Society a lecture on some chemical agencies of electricity, and in the following year announced his discovery of the decomposition of the fixed alkalies. Faraday, who between 1831–40 published his remarkable series of scientific essays, entitled "Experimental Resources in Electricity," was the first to define the laws which hold in this process, and, for the sake of precision, introduced a system of nomenclature which has since been generally employed. The process he called *electrolysis*, the terminal being derived from the Greek of *through* and *disengaging*. The poles where the electricity passes in and out of the body, undergoing decomposition, he called the *electrodes*, meaning the ways. The surface from which the current enters the body is called the *anode*, "the upward way," and the surface from which the current leaves the body is called the *cathode*, "the downward way." The anode is continuous with the positive and the cathode with the negative pole of the battery. Compound substances that are directly decomposable by the galvanic current are called *electrolytes*. The elements of an electrolyte are called the *ions*. Those ions which appear at the anode are called *anions*. Those which appear at the cathode are called *cations*. The anions and cations of an electrolyte are the negative and positive elements, respectively.

Outside of the laws of Faraday, which can be demonstrated by careful experiments, there is very little positive information on the subject. From Faraday's time attempts have been made to classify, according to their chemical composition, the fluids capable of electrolytic decomposition, but without much success. As the resistance of a liquid increases the tests of electrolytic conduction become less and less sensitive; it is not then surprising that views on what constitute an electrolyte have changed considerably.

Davy and the older chemists considered water to be the only electrolyte. Faraday, by decomposing the fused chlorides, dissipated these notions, but still regarded water as the body decomposed when acid solutions were subjected to the electric current. Until chemists were able to produce absolutely pure water it was considered to be a conductor; but as the purity of the water is reached, the conduction decreases until it is nil. It has been

estimated that one ten-thousandth of sulphuric acid is sufficient to render water a conductor. Miller supposed that an electrolyte must be a combination of a conductor and a non-conductor, and so the majority of electrolytes are; but alloys, when fused, act as electrolytes to a certain extent, and $Sn\ Cl_4$, though composed of a conductor and a non-conductor, is not an electrolyte. It would therefore appear that the condition does not depend so much upon the chemical composition of the body as on its molecular arrangement, and that the liability of the body to electrolytic decomposition is in proportion to its conduction and the complicacy of its molecules, modified by their adhesion. Alloys, I consider, would be thoroughly decomposed by the galvanic current, were it not for the adhesion of their molecules. The dilution of acids increases their conduction, apparently, by attenuating the *internal attraction* of their molecules. To this points the fact that $H_2\ O$ and $H\ Cl$, two non-conductors, when mixed form a very good conductor, the best of the liquids. Of all electrical phenomena electrolysis appears most likely to furnish us with a real insight into the true nature of the electric current, because we find currents of ordinary matter and currents of electricity forming essential parts of the same phenomena. Before entering upon the uses, I consider it advisable to give some of the laws and recognized theories on this process.

The fundamental law of electrolysis, established by Faraday and confirmed by the experiments of Beetz, Hittorf and others, down to the present time, is as follows: *The number of electro-chemical equivalents of an electrolyte, which are decomposed by the passage of an electric current in a given time, is equal to the number of units of electricity which are transmitted through it.* Also, *that bodies are decomposed in exactly the same proportion in which they combine.* The electro-chemical equivalent of a substance is that quantity of the substance which is decomposed by the passage of a unit of electricity. Every electrolyte consists of two or more components, which, during the electrolysis, appear where the current enters and leaves the electrolyte, and nowhere else. The actual transfer of the ions through the electrolyte, in opposite directions, is part of the phenomenon of the conduction of an electric current through an electrolyte. *At every part* of the electrolyte through which an electric current is passing there are

two opposite material currents of the anions and cations, which have the same lines of flow as the electric current, and are proportional to it in magnitude. The opposite motion of the ions through the electrolyte would be a complete representation of the electric current. We may compare this motion of the ions to the motions of gases and liquids through each other during diffusion, there being this difference between the two processes, that, in diffusion, the different substances are only mixed together and the mixture is not homogeneous, whereas, in electrolysis they are chemically united and the electrolyte *is* homogeneous. According to Classius, the decomposition and recomposition of the molecules of an electrolyte is continually going on, even when there is no current, and the feeblest electro-motive force is sufficient to give the process a certain degree of direction. In no case, in the body of an electrolyte, is there any decomposition observable; in no case is any gas there liberated. The ions are set free at the electrodes, and there alone. As the ions arrive at the electrodes they are forced into company with atoms of their own kind with which they cannot combine. This forms an opposing electro-motive force, which produces a reversed current when other electro-motive forces are removed. When this reversed electro-motive force, owing to the accumulation of the ions at the electrodes, is observed the electrodes are said to be polarized.

One of the best methods of determining whether a body is an electrolyte or not, is to place it between platinum electrodes and pass an electric current through it for some time, and then, disengaging the electrodes from the galvanic battery, connect them with a galvanometer and observe whether a reverse current, due to the polarization of the electrodes, passes through the galvanometer. Such a current being due to the accumulation of different substances at the electrodes is a proof that the compound has been electrolytically decomposed by the original current from the battery. It is upon this principle that the Faure accumulator and all modifications of it, the numerous storage batteries recently invented, depend for their results. These storage batteries will prove of great benefit to those who are convenient to a dynamo machine, as at a slight cost, and without any inconvenience, they can procure and keep stored up a quantity of power sufficient for any purpose.

The processes of electrotyping and electroplating, depending on electrolysis, can be made to serve the dentist for a variety of purposes. A very good system for the construction of celluloid dentures is with casts, consisting of a shell of copper representing the mouth, exact or modified, mounted upon hard plaster. This shell can be deposited upon a modeling compound impression of the mouth or of a cast by attaching it to a copper wire, coating the surface of impression and ends of wire with finely divided carbon, attaching to the negative pole of a battery and immersing in a saturated solution of sulphate of copper containing one-twentieth of sulphuric acid, and a copper plate connected with the positive pole of the battery. The battery for this purpose should be of considerable power, and the work should remain in the solution from three to five hours.

I also find it very convenient to have at hand the necessary apparatus for electroplating with gold, for there is often a crown made of platinum and gold which, in finishing, has spots of platinum exposed and which, on account of being at prominent angles, is difficult to cover by the blow-pipe. Such a crown can be filled with wax attached to the negative pole from the battery by a platinum or gold wire immersed in a cyanide of gold solution, and receive a heavy coating of pure gold by passing the battery current to it from a pure gold anode. Then there are mouths in which an 18 carat gold partial-plate will become discolored to an objectional extent. As we need this quality of gold for partial-plates, our only remedy is to electroplate the surface with pure gold; also, the ends of clasps which are conspicuous can be made to more closely resemble gold fillings by electroplating them with pure gold.

A very efficient apparatus for pickling such work during construction is an electrolytic cell, in which dilute sulphuric acid is decomposed between an anode, consisting of the gold plate and a cathode of platinum. This is very convenient when once arranged, saving the heating of the pickle each time it is needed.

The eletrolytic is generally much simpler than the chemical process of decomposing compound bodies, and especially is this the case when we wish to carry on the decomposition within the oral cavity. In the bleaching of discolored teeth any strictly

chemical process that we may safely use is necessarily tedious, from the nature of surroundings; and most processes are far from satisfactory.

For a few months past I have been making use of the decoloring properties of nascent oxygen, obtained by the electrolyzation within the cavity of the tooth of acidulated water or a solution of chloride of sodium. In my first efforts in this direction I used the solution of chloride of sodium, as in any attempt at bleaching chlorine naturally suggests itself as the agent for results; but inasmuch as the chlorine is inert except in the presence of moisture, only acting as a dehydrating agent, I think that as good results can be obtained by decomposing the acidulated water, thereby obtaining nascent oxygen or ozone. This, of course, we should be loth to use, unless the acid be the aromatized variety, which, as has been demonstrated has no action on the tooth structures. Then there are circumstances which counter-indicate the use of the *chlorine compound*, such as the immediate proximity of a gold filling in a vital tooth. Nascent chlorine will cause instant and severe pain in a vital tooth, containing a gold filling, with which it comes in contact; therefore, in the presence of such gold filling the water, slightly acidulated, should be used. The paraphernalia for this process consists of two platinum electrolytic needles attached to handles which are in connection with the poles of a galvanic battery; after applying the dam, filling the apex of the root, and flooding the cavity with the fluid to be decomposed, the point of the cathode should be placed at an out-of-the-way edge of the cavity, and the anode passed into it and over the walls, starting at a point furthest from the cathode, and by gradually approaching it thoroughly decompose the liquid. This can be repeated several times, if necessary. If a solution of chloride of sodium is used the chlorine and oxygen will be set free at the anode, and hydrogen and sodium at the cathode. If acidulated water is used the oxygen appears at the anode and hydrogen at the cathode, the acid, by recomposition remaining in the liquid.

In peroxide of hydrogen we have a bleaching compound of considerable efficiency. It has a decided action on organized coloring matters, as is demonstrated by its effect in the bleaching of human hair; it being the active principal of preparation for that purpose. Peroxide of hydrogen is not always available and is rather

prodigal of its virtues, so to be able to manufacture it or its equivalent as needed would help us out on many occasions.

Mr. Schonbein, who, in 1840, first called formal attention to ozone, first observed that it appears at the anode in the electrolyzation of water. It has been estimated that one volume of ozone will purify over 3,000,000 volumes of putrid air. Thus it will be seen, that by evolving nascent oxygen or ozone within the substance of any putrid mass we must effect a very thorough disinfection of it. This, I have been able to accomplish within the pulp-cavity of devitalized teeth containing putrid pulps, with the most satisfactory results. A sponge or flannel covered cathode, moistened with salt water, should be placed upon the lip or cheek over the point of the root to be operated in, and a fine platinum anode introduced into the pulp-canal. This electrode should be slender and finely pointed, so as to be easily but gradually passed to the apex or nearly so. There will soon be observed a frothing of the contents of the cavity, after which the contents may be removed with impunity. The passage of the current will be found to be almost painless, if the anode is first introduced and then the sponge cathode brought gradually into contact. If both hands of the operator are needed in managing the anode and the lips, mirror or what-not, he should have an assistant apply the cathode at the proper time.

There are some subjects who are very susceptible to the galvanic current, so that considerable care is necessary in ascertaining the strength of current to be used. Sometimes one Bunœn cell will give as powerful a current as can be borne, but in most cases the force can be taken from three or four cells.

By this method of disinfection I have been able to proceed with the removal of decomposed pulps without any bad results, where I should have expected trouble from pursuing any other course of rapid treatment.

In electro-therapeutics, or surgery, the term *electrolysis* is practically restricted to the electrolytic decomposition of morbid growths, or parts affected by chronic inflammation, by means of some form of needle electrodes. Although more or less electrolytic action takes place in all applications of the galvanic current, externally or internally, yet the term, when applied to any electro-surgical operation, is understood to imply that

electrolytic action was the leading effect sought for, and that it was obtained by needles, or by some form of metallic electrodes, more or less pointed at the extremity.

Having had no experience in this line, to make the paper more complete I will quote briefly from Dr. Rockwell: He says "that when needle electrodes, connected with the poles of a galvanic battery, are inserted into a tumor a three-fold action is produced: *First*—Decomposition of its fluid constituents. Hydrogen and the alkalies, soda, potassa, etc., go to the negative, and oxygen and the acids to the positive pole. As the body is mostly composed of water, holding salts of soda, potash, etc., in solution, it is a good electrolyte and, in most conditions of disease, undergoes rapid decomposition. Scirrhus and fibroids, when hard and firm, require considerable strength of current, and are electrolyzed with considerable slowness. Erectile tumors, which are almost entirely of fluid composition, can be electrolyzed very rapidly. *Second*—Absorption. Absorption may be hastened both by the chemical changes that take place, the mechanically irritating effects of the needles, and by the transference of the anions and cations. This absorption takes place, both during and after treatment. In some cases it is not at all observed during the operation, but goes on slowly for weeks following. *Third*—Disintegration and atrophy. As a result of decomposition and absorption, and associated with them, the tissues become dried, separated and shriveled, and the tumor decreases in bulk and may entirely disappear. Shortly after the needle is inserted the growth will be seen to change color, the skin soon begins to shrivel and contract like an apple when it is baking."

DENTO-EMBRYONAL HISTOLOGY.

BY W. XAVIER SUDDUTH D.D.S., OF NEW YORK.

The study of the minute anatomy of tissues, by the aid of the microscope, is to-day an established branch in the curriculum of nearly all medical colleges, and should be in all dental colleges. We have made grand advances during the past ten years; let us make the next decade grander still. We constantly hear the complaint from dentists of their non-recognition by the medical profession. Gentlemen, the fault lies in ourselves. Let us prove ourselves worthy of recognition, and it will be accorded without reserve. What we of the "D.D.S.'s" need, is more D.D.S., and not more degrees. One of the essentials for successful practice is a thorough knowledge of the tissues which we are called upon to treat. It is my aim, in this paper, to give some of the methods for obtaining and preparing tissues especially pertaining to dental anatomy, and an interpretation of what they will show, with the view of interesting the members of the society in a subject upon which every one, who cares to be well or even fairly posted, should be familiar with in an experimental way.

The methods of hardening, cutting, staining, and mounting, that tissues must go through before they are ready for examination, seem tedious at first; but when we understand the why and wherefore, they are simple enough, and we follow the regular routine as a matter of course; any other way would be difficult. As regards the expense, the beginner does not require a very extensive list of apparatus; as he advances in his knowledge he can add, little by little, and thereby not feel the additional outlay; the greatest outlay being in the higher-power objectives for finer histological study. Low powers and topographical studies are best suited for the tyro in microscopy, and are not expensive.

As regards reagents and stains, the fewer and simpler that obtain a given result, the better; leave complicated processes and staining to more mature years. Twenty-five dollars will cover the outlay necessary to demonstrate the development of the teeth in the most practical manner. I would advise the purchase of a cheap microscope, as you will find that, by the time you have learned to properly use your instrument, it will not be worth very much; the same would hold true of a more expensive one.

There are a great many hardening fluids, but for our needs a one-per cent. solution of chromic acid is best. It decalcifies as well as hardens. This is made by adding thirty grains of chromic acid to a quart of water. The tissues should be put into the solution as fresh as possible, and the fluid changed every other day for one week, then left until completely decalcified. They are then to be placed in a seventy-five per cent. alcohol to remove the chromic acid. This should be changed as often as it becomes cloudy. Tissues can be prepared in this manner, in quantity, and kept in alcohol until needed.

For the demonstration of the development of teeth, I have found fetal pigs the most readily obtained and the easiest studied. A series of these should be secured, ranging in length from one inch to six inches; the first presenting the beginning of the development of the teeth, and the last being as large as practicable to study in the pig. For sections of fully-developed teeth, young kittens or rabbits are best adapted. After obtaining the fetuses, disarticulate the inferior maxilla, and place in separate bottle, filled with one per cent. solution of chromic acid; suspend the jaw in the fluid by means of a string, label, cork, and put away. After the jaws are completely decalcified, which can be ascertained by trying to pierce them with a needle, they may be imbedded in one of three ways: *First*—They may be placed between pieces of hog's liver, previously hardened in alcohol, and thin sections cut with a razor—a flat ground one being best. Very good sections can thus be obtained. *Second*—Make a thin mucilage by dissolving picked gum acacia in warm water; place the tissues in water for twelve hours, then put them in the mucilage over night; remove and place in alcohol to precipitate the gum; hold between pieces of liver and make

sections. This method keeps the parts *in situ* fairly well, which is of great advantage in the study of the development of the teeth. The disadvantage is that the sections must be placed in water to remove the gum before staining, with consequent risk of displacing parts. They can be mounted in glycerine, and studied without other staining than what they have received from the chromic acid. These, however, do not make permanent specimens. *Third*—A new method of imbedding has lately been given to the profession by Scheiferdecker, that has very greatly added to the advance of microscopical technique, viz., celloidin. Celloidin is a perfectly pure preparation of pyroxyline. The best method of preparing this imbedding mass consists in making a saturated solution of celloidin in equal parts ether and alcohol. The decalcified specimen is first placed in equal parts ether and alcohol for twenty-four hours, then soaked for the same length of time in the celloidin mixture, so as to thoroughly penetrate the tissues with the celloidin; next make a small paper box, in which place the specimen and cover with the celloidin mixture; then place under a bell-glass, raised slightly from the table, and leave over night. The imbedding mass, or mixture, will shrink very considerably, for which allowance must be made in size of box and quantity of mixture used; the shrinkage is due to the evaporation of the ether and alcohol. When the mass is sufficiently hardened, which will require a longer or a shorter time according to the size of the mass, place in a mixture of equal parts alcohol and water to harden; then remove the paper box, and cut sections with a flat razor dipped in equal parts alcohol and water; float the sections off on the same fluid. Strong alcohol softens the mass, so must not be used. The sections may be kept in a bottle, filled with equal parts of water and alcohol, until needed for use.

A word as regards section cutting may not be amiss. Besides the flat razor, which will do for all ordinary work, there are several microtomes in use, the best of which is Thoma's. This microtome is capable of cutting sections .001 of a m. m. in thickness: the thinnest known are .002 m. m. The inclination of the oblique plane upon which the object-holder slides is 1 in 20, consequently the section will be $\frac{1}{20}$ of a m. m. thick when the carrier is moved one m. m. on the oblique plane. Every revolution of the carrier

screw pushes the object-holder .03 m. m. The periphery of the carrier-screw is divided into 15 parts. Turning the screw one of these parts makes a section .001 m. m. thick; most of my sections are .015 to .025 m. m. thick, or from $\frac{1}{1000}$ to $\frac{1}{1600}$ of an inch. Having cut our sections, we are ready for the staining and mounting process.

If it is desired to mount in balsam, which I consider the best for permanent preparation, either one of two methods may be used: *First*—The dehydrated stained specimens may be placed in a dish containing oil of cloves, and the celloidin removed, after which they may be mounted in the usual manner. *Second*—The unstained sections may be placed on the slide on which there has previously been dropped a sufficient quantity of oil of cloves to fix, but not to float the section, after which it may be stained on the slide, dehydrated and mounted in the usual way. The latter is especially applicable to very large, thin sections, as it obviates the necessity of re-handling.

I have found that embryonal tissues do not permit of very elaborate and complicated staining methods; the brilliancy of the result depends on a combination of different tissues with their different chemical reactions. These are found only in mature tissues, especially in the lower order of animals. The best result I have obtained has been in sections of the head of the newt and common snake. For the demonstration of the teeth, only four stains are requisite, viz.: Hæmatoxylon or logwood, eosin, picro-carmine and methylgreen, valuable in the order named; or as double stains in combinations of H. and E., H. and Picro-C., E. and G., Picro-C. and G. Double stains give the best results. Tissues that have been hardened in chromic acid require to be placed in a one per cent. solution of carbonate of soda from 15 to 20 minutes, to remove the chromic acid. To double stain sections thus prepared with hæmatoxylon and eosin, which is by far the best double stain for general use, add ten drops of hæmatoxylon to a watch glass of distilled water, place the sections in it, and let them remain one or two minutes or until they assume a light straw color; thoroughly wash in ordinary water and place in the eosin stain. Dehydration and eosin staining can both be accomplished at the same time; a matter of considerable importance, if you are going to mount in balsam. To do this, keep on hand a saturated solution

of eosin in absolute alcohol. When a stain is wanted, add a few drops of this solution to a watch-glass of absolute alcohol. Having stained your tissues, wash in absolute alcohol, and place on the slide; with a camel's-hair brush or pipette drop several drops oil of cloves on section, set aside and allow to clear up, which will require several minutes. You can examine, from time to time, under the microscope without placing the cover-glass. When sufficiently clear remove surplus oil of cloves, and drop on section sufficient balsam, thinned with chloroform, to cover the section; then place cover-glass and put aside for balsam to harden.

For the other double stainings, place several sections in a one-half per cent. solution of picro-carmine, made after the following formula: *Carmine, 1 gramme; liquor am., 4 c. c. m.; water, 200 grammes; mix and add 5 grammes picric acid; shake thoroughly. After settling, draw off so as to leave the undissolved picric acid behind. Evaporate in a shallow dish in open air. A red powder is thus obtained with which a one-half per cent. solution with distilled water is to be made and allowed to stand several days, when it can be filtered, and is ready for use. Sections should be allowed to remain in this solution at least twenty minutes; longer does not matter. When sufficiently stained, remove to a watch-glass of distilled water, which has previously been acidulated by adding a few drops of acetic acid; this brings out the color and fixes it. To double stain these sections with hæmatoxylon, place in dilute hæmatoxylon for a few minutes, wash in water, dehydrate in alcohol, place on slide, clear up with oil of cloves, and mount in balsam. To double stain with methylgreen, take the sections previously stained in picro-carmine and place them in a one per cent. solution of methylgreen in alcohol and water (10 parts alcohol 90 parts water) for several minutes; this will over-stain. Next, place in absolute alcohol, which will remove the excess of green. When the right shade is procured, which can be ascertained by trial, place on slide, add oil of cloves to clear up, and then mount.

To double stain with eosin and green, first stain with eosin, and then wash with water, to which has been added a few drops hydrocloric acid—this fixes the stain; then over-stain in green, decolorize in alcohol, place on slide, add oil of cloves and mount.

* Frey.

I have given you the formula for the different stains; they can be bought, however, already prepared, from any dealer in microscopic goods, but you will find it best to prepare your own stains.

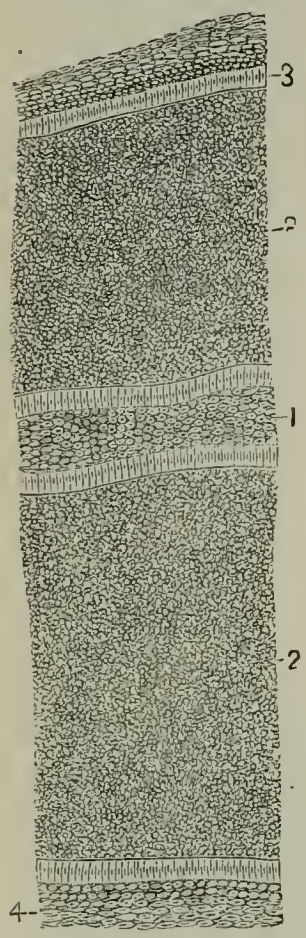

CHART No. 1.

Having thus obtained, stained and mounted a series of specimens, let us study them and see what they will show, commencing with our smallest fetal pig, 2½ centimetres in length, of which we have made longitudinal transverse sections of its inferior maxilla. The first sections remove the surface of the gum and simply show epithelial tissue; but a few sections deeper we find a furrow or band filled with small round cells. The outer sides of this band are composed of cylindrical cells. This band extends the entire length of the jaw; on either side of it the jaw is made up of embryonal tissue, while on its labial and lingual aspect we find epithelium.

A PORTION OF A LONGITUDINAL TRANSVERSE SECTION OF THE BAND. PIG, 2½ CENTIMETRES.

1. Band.
2. Embryonal tissue of jaw.
3. Outer layer of epithelium.
4. Inner layer of epithelium.

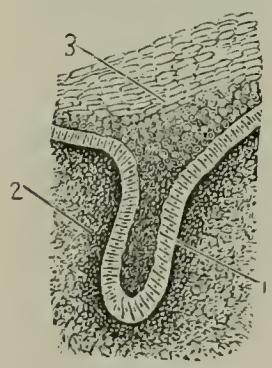

CHART No. 2.

VERTICAL TRANSVERSE SECTION OF BAND. PIG, 2½ CENTIMETRES.

1. Band.
2. Embryonal tissue.
3. Epithelium of mouth.

These cuts are magnified 80 diameters, unless otherwise stated. R. & J. Beck, obj. ⅜.

Our next fetus is three centimetres long; sections from its inferior jaw cut in a longitudinal transverse direction, show band expanded at its deepest extremity by internal proliferation of cells.

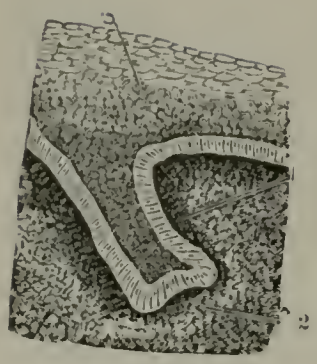

CHART NO. 3.

VERTICAL TRANSVERSE SECTION OF BAND OF 3-CENTIMETRE PIG.

1. Band expanded.
2. Indentation at deepest portion of band.
3. Epithelium of mouth.

Just previous to the formation of the cord the band seems to be indented on its deepest surface, its entire length, and a "lamina" formed on its inner side; sections through this portion of the band show six lines of epithelial cells, instead of four, as will be seen if made earlier or through a more superficial part of the band.

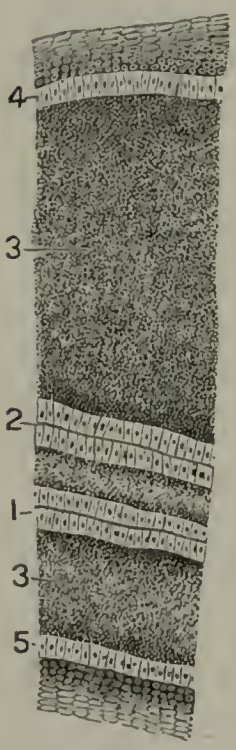

CHART NO. 4.

PORTION OF LONGITUDINAL TRANSVERSE SECTION OF BAND OF 3-CENTIMETRE PIG.

1. Band.
2. Lamina.
3-3. Embryonal tissue of jaw.
4. Inner layer of epithelium.
5. Outer layer of epithelium.

The space between 1 and 2, filled with embryonal tissue, corresponds to No. 2 of previous cut. The indentation having progressed somewhat farther, produces the lamina; and the section being made at the deepest portion, shows the two layers of epithelial cells, which form the lamina in apposition, as also are those of the band.

From the inner side of this lamina, at such portions as correspond to the position to be occupied by the temporary teeth, small buds shoot out and extend until they become slender cords.

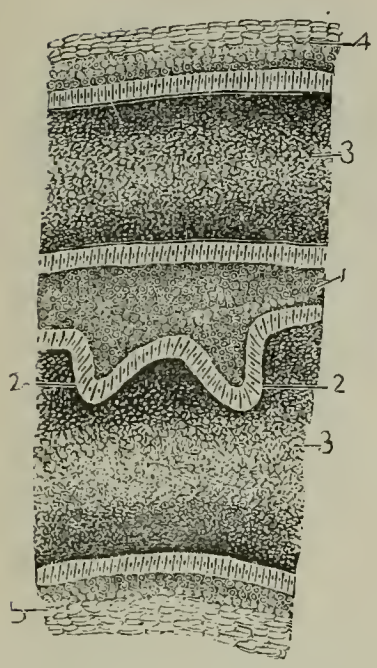

CHART NO. 5.

LONG, TRANSVERSE SECTION OF JAW OF 3½-CENTIMETRE PIG, IN MEDIAN LINE, SHOWING CORDS FOR TWO INFERIOR CENTRAL INCISORS.

1. Band.
2-2. Cords.
3-3. Embryonal tissue.
4. Outer layer of epithelium.
5. Inner layer of epithelium.

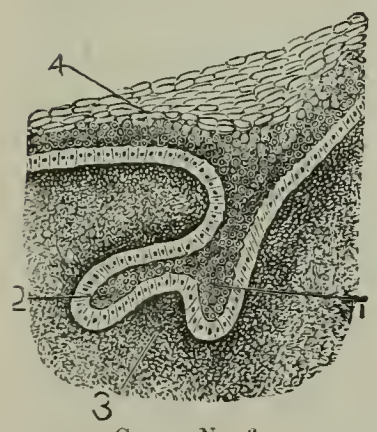

CHART NO. 6.

VERTICAL TRANSVERSE SECTION OF CORD OF INFERIOR CENTRAL INCISOR, SAME AGE FŒTUS AS ABOVE.

1. Band.
2. Cord.
3. Embryonal tissue.
4. Epithelium of mouth.

Vertical transverse sections of the band, in the intervals between the cords, show that the band has shrunk back into its original V shape, the tenison having been apparently relieved by the bursting forth of the cord. Pig 3½ centimetre, shows the internal development of cells, continuing with unabated energy in the deepest portion of the cord of the inferior central incisors, to which we shall confine ourselves in future descriptions. Vertical transverse sections from the jaw of a 4-centimetre pig show very little change.

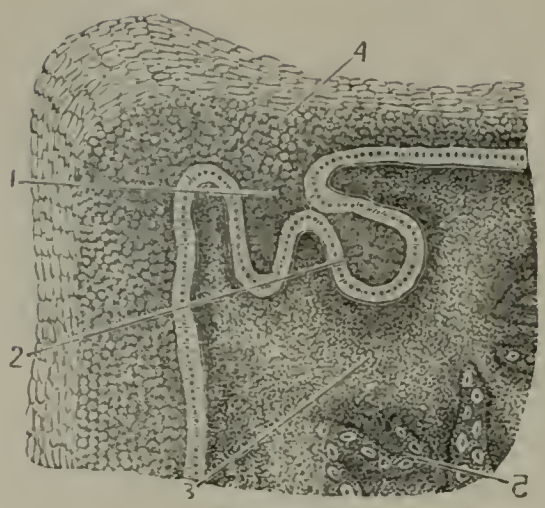

CHART No. 7.

VERTICAL TRANSVERSE SECTIONS OF JAW OF 4-CENTIMETRE PIG.

1. Band.
2. Bulbous cord, filled with small round cells.
3. Embryonal tissue.
4. Epithelium of mouth.
5. Ossifying cartilage.

The lower portion of the cord has increased slightly by internal proliferation and now presents a bulbous appearance, and very much resembles a Mattson syringe with a short nozzle. With these changes it has become more deeply imbedded in the substance of the jaw. At first, the cord stood nearly at right angles to the band, but as development progressed it curved in towards the axis of the band, thus assuming a sickle shape.

A longitudinal transverse section made of the jaw, at this stage of development, will show a vertical transverse section of the cord lying beside a longitudinal transverse section of the band. Studying sections from jaw of a 5-centimetre pig, we notice the bulbous portion of the cord has become flattened at its deepest extremity. This flattening is caused by contact with a new element, viz., the dentinal papilla, which now enters into the future development of the tooth. The papilla or pulp is a growth from the sub-mucous tissue of the jaw; its growth is upward or toward the surface of the jaw, while the growth of the cord has been downward, or into the substance of the jaw. Just how the papilla is formed or why it should come into contact with the cord I am unable to demonstrate. The cord now presents the appearance of a "chip-blower," *i. e.*, pear shaped, and shows the beginning of the process of invagination, by which the two tunics are formed.

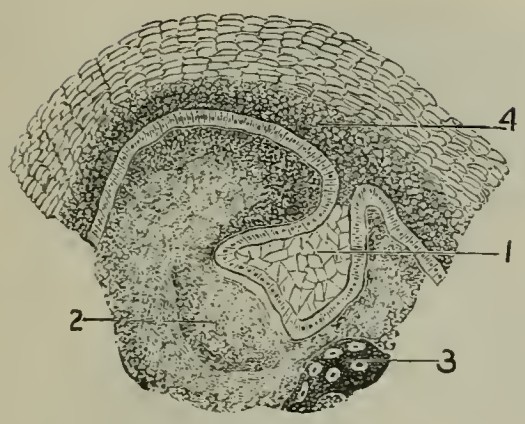

Chart No. 8.

Vertical Transverse Sections of Jaw of 5-centimetre Pig.

1. Pear-shaped cord, small round cells, changed into stellate cells.
2. Dentinal papilla.
3. Ossifying cartilage.

Sections from jaw of an 8-centimetre pig show the process of invagination almost complete —the concave surface of the cup-shaped cord or enamel organ, as we will now style it, filled with the almost fully-developed pulp.

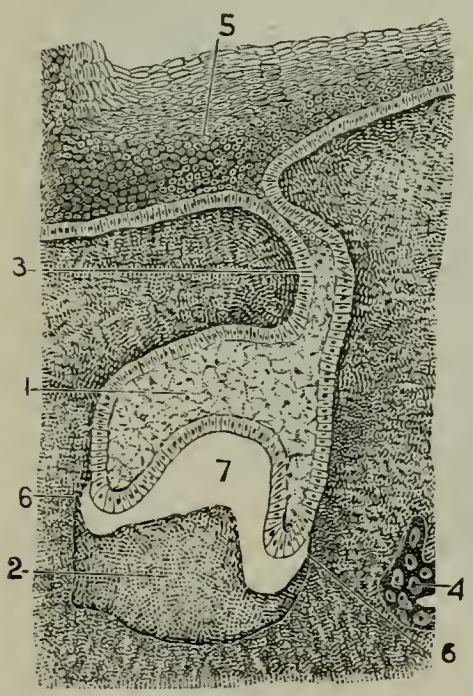

Chart No. 9.

Vertical Transverse Section of Jaw of 8-centimetre Pig.

1. Enamel organ.
2. Dentinal papilla.
3. Neck of enamel organ.
4. Ossifying cartilage.
5. Epithelium of mouth.

6-6. Connective tissue processes arising from sides of dentinal papilla to form cement organ.

7. Space caused by shrinkage.

The interspace between the two tunics is now occupied by a stellate reticulum, formed from the small round cells that originally were enclosed by the cord. The enamel organ is still connected to the epithelium of the mouth by the neck of the cord. Springing up from the base of the pulp is seen a connective tissue envelope, which is to enclose the enamel organ in a complete sack, the exact office of which is not fully understood. I hold that it plays an important part in the development of cement.

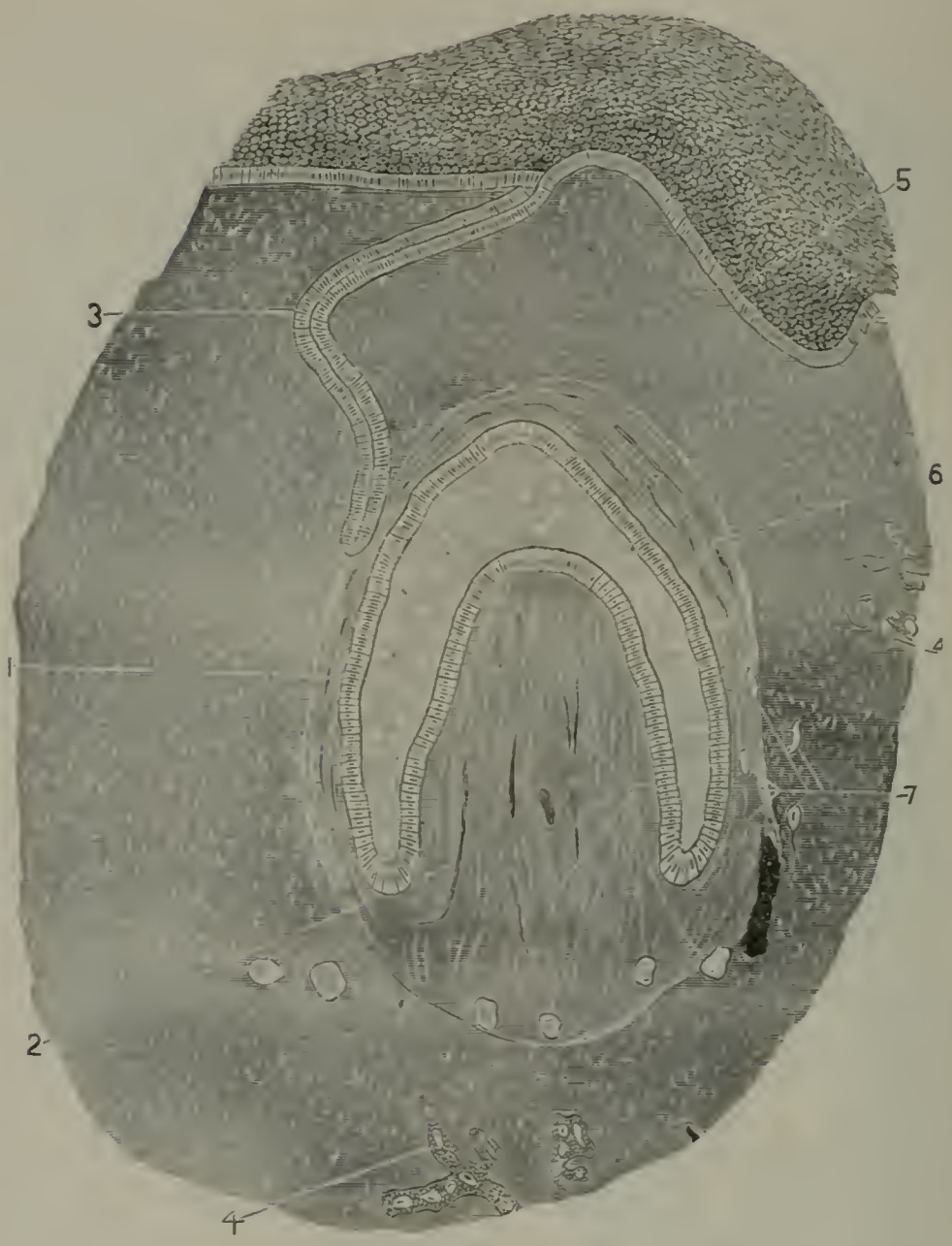

CHART No. 10.

VERTICAL TRANSVERSE SECTION OF JAW OF PIG 10-CENTIMETRES LONG INJECTED, SHOWING BLOOD SUPPLY TO ENAMEL AND CEMENT ORGAN.

1. Enamel organ.
2. Dentinal papilla or pulp.
3. Cord for permanent tooth.
4. Ossifying cartilage.
5. Epithelium of mouth.
6. Connective tissue envelope or cement organ.
7. Blood vessels. (These are represented by the dark lines and are seen both the pulp and cement organ.)

What we have said thus far, simply refers to the development of the temporary teeth.

At about the fifth month in the human, and in the pig 10-centimetres long, we find a bud springing off from the side of the cord of the temporary tooth; this is to form the cord for the permanent tooth, which is to take the place of the temporary one. This budding arises from the lingual aspect of the neck of the cord and passes down on that side of the now fully developed enamel organ of the temporary tooth. This description holds good for all, except the cords of permanent molars. These arise from the distal face of anterior teeth, and pass down on the same side.

Turning our attention now to the pulp, we find lying on its outer surface a row of cells called odontoblasts. From these the dentine is developed by calcification around the fibrils, which are thrown out from their outer periphery; calcification beginning at a point farthest from the pulp and proceeding inward, the fibrillæ remaining as the contents of the dentinal tubuli. The basement membrane, the presence of which is doubted by most observers, would lie between the odontoblasts and the cylindrical epithelium, which composes the inner tunic of the enamel organ.

As regards the development of the enamel there are many theories. Some hold that the enamel is a differentiation of a dentinal basis; but the fact that calcification of both dentine and enamel, beginning at the same line, progresses in opposite directions, makes that ground untenable. Others hold that the enamel results from the calcification of the enamel cells themselves. From a casual examination this does appear to be so; but if such were the case, then at the beginning of calcification the enamel cells should correspond in length to the length of the developed enamel prisms, and the decrease in the length of the enamel cells should be commensurate with the increase in the thickness of the enamel, or the enamel cells should extend on themselves as calcification progresses, which phenomenon has not been established.

I hold that the cylindrical cells of the inner tunic of the enamel organ become changed into secreting cells, ameloblasts; and through their agency the lime-salts, stored up in the stellate cells of the enamel organ, are laid down, layer upon layer, on the dentine in the form of enamel prisms, which correspond in diameter

to that of the ameloblasts. If a newly formed layer of enamel, which lies on the dentine in a thin plate, be torn off from a thick section of tooth and mounted, the outer surface will be seen to be pitted,* that is, provided you have succeeded in getting the enamel in just the right stage of calcification. The periphery of the pits correspond to that of the ameloblasts. The ameloblasts during the formation of enamel seem to be impregnated with lime-salts, and break with a clean fracture at almost any point; sometimes near the newly formed enamel and sometimes at a point just inside the nucleus.

C. S. Tomes noticed the fact of the probable impregnation at the end nearest the forming enamel, and cited it as proof of the actual conversion of the ameloblasts into enamel prisms. The impregnation of both ends of the cells is accounted for in the fact that they have become secreting cells, and are carrying lime-salts from the enamel organ to the forming enamel. The pits in the newly formed enamel are the central portion of the prisms, from which the still uncalcified exudate has been drawn by the ameloblasts when they were separated from it.

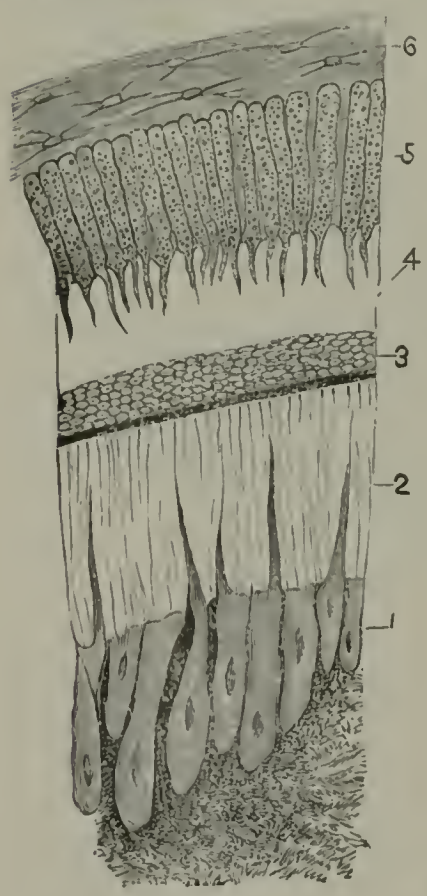

CHART No. 11.

SECTION OF FORMING ENAMEL AND DENTINE. ZEIS, OBJ. $\frac{1}{15}$.

1. Odontoblasts.
2. Dentine.
3. Thin layer of enamel, showing pits.
4. Space caused by shrinkage.
5. Ameloblasts, with Tomes' processes, extending into space 4.
6. Stratum-intermedium.

This semi-calcified material, which adheres to the ameloblasts, gives the appearance of a fibril or prolongation of the cells themselves. These fibrils, which have been called Tomes' processes, I consider as thus being

*Chart No. 11.

mechanically made, for they do not always appear, but depend upon a certain condition of the calcific material. Out of many hundreds of sections examined I have only succeeded in demonstrating them a very few times; they do not occur persistently, as do the fibrillæ of the odontoblasts. I have succeeded in demonstrating them in sections of pig's teeth, under favorable circumstances, where they showed very plainly indeed, being nearly or quite as long as the ameloblasts themselves, and several times longer than the enamel was thick. However, my observation leads me to conclude that, as a rule, the ameloblasts separate so as to leave a comparatively smooth line or plate, that is, provided the sections have been sufficiently thin so as not to show a ragged edge from the overlapping of the cells themselves. I have never been able to demonstrate processes that would lead me to infer the least analogy between them and the fibrillæ of the odontoblasts. If Tomes' processes were the analogue of the fibrillæ of the odontoblasts, why should we not find the enamel calcified similarly to the dentine, and the processes remaining as the *contents* of the *enamel tubes;* but it is well-known that the latter is not the case. The fact that the ameloblasts become widened in the process of change into homogeneous membrane, militates against the theory of the direct conversion of the ameloblasts into enamel. This is plainly shown in sections of the incisor teeth of rodents, and will be referred to farther on, when treating of that subject. That the enamel organ exists in the commencement of the development of the teeth is now generally admitted. There are certain classes of teeth, however, that do not possess enamel, and in which, although there is an enamel organ developed, the stellate reticulum fails to appear. In all cases where there is to be a deposit of enamel we find a stratum-intermedium fully developed; and my observation leads me to believe that the calcification of the enamel is largely due to a calcific material stored in the meshes of the stellate cells of the stratum-intermedium. The counterpart of this is found in the development of bones where the cartilage is first calcified, to be melted down and rebuilt under the superintendency of the osteoblasts. The presence of a non-shrinkable material in the meshes of the stellate cells of the stratum-intermedium accounts for the different results, as regards shrinkage in the processes consequent upon preparation of tissues.

Previous to the beginning of development of the enamel we find little or no shrinkage of the enamel organ during the hardening and decalcifying processes, provided the hardening is accomplished first. It is only after the stellate cells have given up a portion of their lime-salts, either by forming enamel, or by being decalcified before hardening, that any considerable shrinkage occurs; the shrinkage in the first instance is localized in that portion nearest the forming enamel, in the latter it is general. The shrinkage on the part of the enamel organ, in any case, is more apparent than real; the space formed by the separation of the enamel from the ameloblasts being largely due to the greater shrinkage of the dental pulp, which draws the formed dentine and enamel down from the sides of the cone-shaped enamel organ. If the stratum-intermedium is, as has been stated, very rich in albumen, and does not contain calcific material in large quantities, there would be a very great shrinkage in preparation, due to the rapid taking up of its water by the acids used in decalcifying, which is not the case previous to the commencement of the formation of the enamel. But after calcification has begun, and the stratum-intermedium has given up a portion of its lime-salts, then a more or less shrinkage is noticed; or if decalcification is accomplished by hydro-chloric acid, which has no hardening property, and the tissue is afterwards hardened in alcohol, we notice the same phenomenon, which is due to the same cause, viz., the giving up of its lime-salts previous the coagulation of the albumen in the substance of the tissue. Thus I see in the stratum-intermedium an essential agent in the process of the formation of the enamel, and not a mere occupier of the space to be taken by the formed enamel, as some would have us believe.

The stratum-intermedium is the storehouse, so to speak, of the calcific material from which the enamel is derived; the width of the space so occupied bearing, as a rule, a proportionate thickness to that of the enamel. This is best illustrated by the development of the molar teeth, where it is plainly shown. The enamel cells having been changed into ameloblasts, the enamel organ undergoes a retrograde metamorphosis. The ameloblasts take up the calcific material contained in the stratum-intermedium of the enamel organ, and deposit it, layer upon layer, on the dentine.

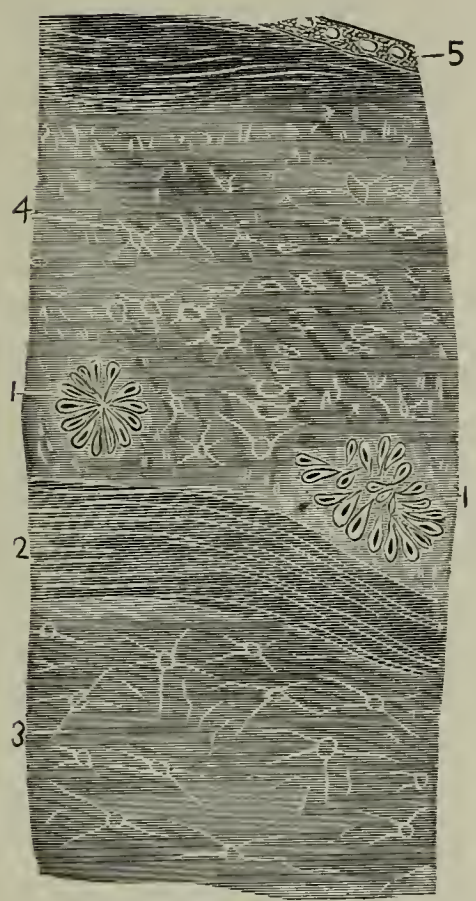

CHART NO. 12.

SECTION OF OUTER TUNIC ENAMEL ORGAN.

ZEIS, OBJ. $\frac{1}{15}$.

1-1. Whirls of epithelium, composed of outer tunic of enamel organ.

2. Fibrous tissue layer, resulting from the stellate cells which have given up a portion of their lime-salts.

3. Stratum-intermedium.

4. Connective tissue envelope.

5. Blood vessel.

Concomitant with this process the epithelial cells, which compose the outer tunic of the enamel organ, are gathered together in whirls of epithelium, and resorbed into the substance of the jaw.

The stellate cells lose their star-like form, become elongated, and are condensed into a fibrous tissue layer against the adamantoblasts. The latter, after secreting the enamel, become shortened and widened. This transformation gradually continues, until they, with the stratum-intermedium, are changed into a perfectly homogeneous membrane. This change in the ameloblasts is first accomplished at the cutting edge of the tooth, opposite the thickest portion of the enamel; here the cells have entirely lost their outline. But where the deposition of enamel has progressed less, the cells are square, and where no enamel has been deposited, the cells retain their original cylindrical form. These changes can be seen in well-preserved specimens of the inferior incisor teeth from jaw of rabbit. These teeth develop from persistent pulps, and also have a persistent enamel and cement organ.

Enamel is formed on the labial face and cement on the lingual. The change from fully developed enamel organ, with stratum-intermedium, to perfectly homogeneous membrane is plainly seen

progressing from base to cutting edge of tooth, where it forms the cuticula dentis or Nasmyth's membrane. As regards the development of the dentine of the root of the tooth, it is formed as the dentine of the crown by a secretion from the odontoblasts, calcified around the dentinal fibrils; also a prolongation of the odontoblasts. Calcification, beginning at a point farthest from the pulp, progresses inward. At first the apical foramen is large, bounded by the thin layer of dentine, but as the dentine increases in thickness the foramen gradually narrows, until it presents the appearance seen in the fully formed tooth, viz., a constriction of the pulp-canal.

The dentine and cement of the root are formed between the body of the odontoblasts and the connective tissue envelope which surrounds the developing tooth; this envelope is lengthened with the pulp in the process of elongation of that organ previous to the formation of the root. If we examine the connective tissue envelope we will find it richly supplied with blood vessels, which form a complete network of capillaries.* It is supposed that the white corpuscles escape through the walls of the capillary vessels and become changed into osteoblasts, which in some manner superintend the formation of cement. The development of cement is analogous to sub-periostial formation of bone in long bones, and is, consequently, subpericemental. In the herbivora, cement is deposited over the entire tooth; in the carnivora the tooth erupts through the upper portion of the sack before the process of cement formation begins, and cement is deposited on the dentine of the root; in the rodentia, however, we find cement deposited on the lingual face of the tooth and enamel on the labial. Secondary dentine is calcified in the same manner as primary dentine. Exostosis of the roots of teeth is the analogue in structure of the first formed cement. If the source of nutrition had not been cut off from the enamel organ by the eruption of the tooth, I have no doubt that caries of enamel would have been repaired in a manner similar to caries of bone. In conclusion, enamel cement and dentine are secreted by special organs, which persist after the formation of the different parts of the tooth, odontoblasts as odontoblasts, cement organ as pericementum, and enamel organ modified by change in surroundings, as Nasmyth's membrane.

*Chart No. 10.

DISCUSSION.

DR. BLACK: I am glad to see this work going on—especially do we need more clear illustrative work. The pursuance of this study is a laborious task. It involves long work over the instrument to furnish material for such a paper. The paper goes over the ground correctly.

DR. SUDDUTH explained that in the ten centimetre pig or five month fetus the outer tunic of the bulb becomes atrophied, and assumes a beaded appearance.

DR. INGERSOLL: Does the inner layer of the follicular wall form the peri-dental membrane?

DR. SUDDUTH: It does.

DR. INGERSOLL: The peri-dental membrane is not sufficiently recognized by dental writers. It is common for all the tissues to be enumerated, and it is omitted. If the peri-dental membrane belongs to the dental follicle it belongs to us.

DR. BLACK: I am surprised to learn that the peri-dental membrane is ignored by dentists. I was foolish enough to deliver several lectures on that subject during the past winter.

IRREGULARITIES IN HUMAN TEETH; OR, DENTAL TERATOLOGY.

BY JOHN J. R. PATRICK D.D.S., OF BELLEVILLE, ILL.

There is nothing more certain to the reflective mind than the intimate relation of all the sciences; for there is no single branch of natural science, when properly studied, but places every other branch under contribution.

Thus the geologist, in constructing the history of the earth, has to consult chemistry, astronomy and mechanical philosophy at one extremity, and all other branches of natural history at the other; exclude paleontology, botany, zoology, or conchology from geology, or any one of the branches of human knowledge which

may be capable of furnishing facts or ideas that can be reduced to law, and just so far will it be defective as a science. What is true of geology is equally true of the science and practice of dentistry; neglect all or any of the sciences upon which it is founded and devote all your energies to the operative, or bread-and-butter department, and the profession, which is confided to our keeping, will dwindle to insignificance, and become unproductive and puerile in its character. The intelligent practice of dentistry, like that of medicine, is the result of science rather than an individual science, and when either becomes, in whole or in part, deprived of its natural sustenance it becomes enfeebled. For all that the *theory and practice* of medicine or dentistry can claim, or does claim, is scientific associations; separated from anatomical, physiological, and pathological relationship, they would become mere trades or crafts, and justly fail to attract intelligent students or command the respect and confidence of mankind.

I have been led to these reflections by perusing a number of articles on the irregularity and the degeneracy of the human teeth, which have appeared, from time to time, in our dental journals and Society Transactions; and it is remarkable with what unlimited confidence the writers rely upon their own limited observation, ignoring, in most instances, the existence of well established laws, laid down in the text books of the different branches of natural science, which relate to the subject upon which they write.

I propose to present a few facts for your consideration, concerning the teeth of man and other animals, which will serve to explain the cause of irregularity and decay of the teeth of man, while other animals are exempt from both irregularity and decay, excepting where mal-conditions exist, the result of accident, or the multiplicity or lack of structure, as in monstrosities. "The great deviation which occasionally occurs in the development of man and the lower animals from the normal type, and which is commonly embraced under the general term 'monstrosities,' is a subject so full of interest as not only to have attracted the attention of common observers, but to have engaged the profound consideration of philosophers in all ages;" hence we have a science called "teratology," an appropriate name for the science of monstrosities. To persons whose attention has not been directed to

this field of inquiry the question will arise, For what purpose is this investigation? To which it may be replied, that the subject is invested with profound interest in its relations to embryology and general physiology, as it embraces all the conditions of development in all the multiform classes of organized beings, and that there is scarcely any general fact, any anatomical or physiological law on which it does not reflect light, and either confirm or disprove. Further, "the relative importance, and even the necessity, of certain organs in the maintenance or continuance of life have been chiefly learned from a careful examination of cases of monstrosities. Nearly every organ in the human body has been found absent in a series of individual cases; in some instances only admitting of fœtal or intro-uterine life, while in others more or less permanent viability has been proven to be compatible with the lowest rudimentary development, or entire absence of organs which are commonly regarded as essential to life. For example, cases have occurred in which the brain was entirely absent, while every other portion of the nervous system was normally developed. In others, a well formed body has existed in which the vascular system has been completely developed and symmetrically distributed, and yet no rudiment of a heart could be found—thus demonstrating the independence of the development of nerves in relation to the brain, and of blood-vessels to the great central organ of the circulation. The history of anomalies of organization is no longer to be regarded as a mere detail of prodigies and sports of nature, resulting from supernatural causes, but requires to be studied as a science which is governed by natural laws, no less certain in their operation and results than those which are concerned in normal development."* What is true of the abnormal development of the body, as a whole, is equally true of any portion of it; we have retarded developments of certain portions and excessive developments in other portions of the same body, so slight in the majority of instances as to escape detection. The anchylosis of the sutures of the cranium determines the form and size of the skull, and the same is true in regard to the bones of the face; a failure of the palate process to anchylose with its opposite would result in what is

* See "Essay on Human Monstrosities," by G. J. Fischer, M. D., in the Transactions of the New York State Medical Society, of 1865-66-67-68. The most exhaustive scientific treatise on the subject of "Teratology," in the English or any other language.

understood to be cleavage or simple division of the maxillary bones. The non-development of the intermaxillary bone or incisive process when entirely wanting is generally accompanied with cleft-palate, with or without harelip, but a partial development of the intermaxillary bone may occur without cleft-palate or harelip, and therefore carry no incisor teeth. (Fig. 1.) The intermaxillary bone may be so narrow, laterally, that the lateral incisors will be missing, as in most of the rodents, while the maxillary bones will be developed forward, carrying a duplicity of canines on either side; the two posterior ones, right and left, frequently being deciduous. (Fig. 2.) So also, in the case of a laterally contracted intermaxillary, it may carry four incisors, the two laterals immediately behind the two centrals, after the manner of rodents of the genus *lepus* (hares and rabbits.) Now, in the felines and carnivora the intermaxillary bone carries six incisors, and in some species, as the opossum, the same bone carries ten incisor teeth; and there are cases in man where the same bone carries five or six, but the supernumerary teeth resemble, in form, the two external incisors of the carnivora; thus that which is normal in the lower order of animals becomes abnormal in man.

FIG. 1.

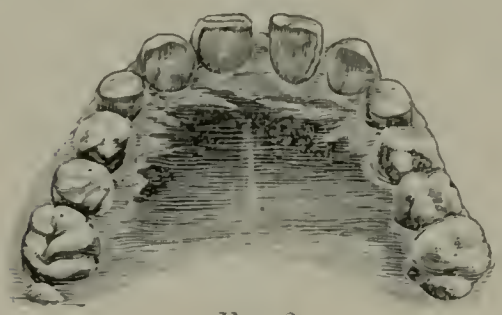

FIG. 2.

Again the intermaxillary bone may be too short, vertically, but broad enough, laterally, to carry the four incisors; yet these incisors, although well developed, will be too short to occlude with the lower incisors when the molar teeth are brought in contact. (Fig. 3.) In some persons the two front incisors are so far apart that

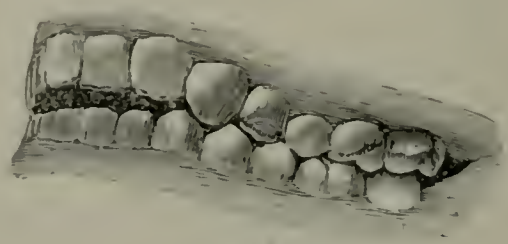

FIG. 3.

a more or less interspace exists between them; in this space there are sometimes one or two very anomalously formed teeth; sometimes these teeth are found on the palatine arch, immediately behind the middle incisors, but never occurring beyond the limits of the intermaxillary bone. The reason why the front incisors are found sometimes so far apart is owing to the unusual thickness of the two dental septa, which separate the teeth from each other, and the spongy mass of osseous substance which unites the two walls of the maxillary bones in this region. The interspace is sometimes found between the middle incisors of the inferior maxillary, originating from the same cause, an excessive development of the dental septa, or the too distant location of the dental germs. Any of the organs of the body may be abnormally placed, and may exceed in number that which is usually the normal condition, without presenting any irregularity of form. An incisor, for instance, may present its margins to anterior and posterior in the place of its anterior and posterior surfaces; the right eye may be smaller than the left and the vision not be impaired, and there may be three regularly shaped bicuspids on one side (Fig. 4), or six well formed fingers on one hand. If, however, the shape of a particular organ is different from that which is the rule, and if two or more organs are conjoined, they are malformations, which must be considered as products of a physiological process. Teeth, the crowns of which are only half enameled, or teeth that are bent in any manner, club-feet, two teeth concreted, fingers joined, or partial union of twins, are examples of a physiological process.

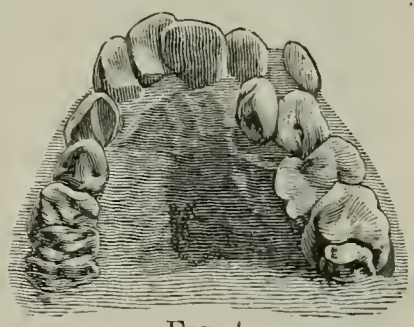

FIG. 4.

The dental organs of the human subject present many anomalies; there are found on the enamel of otherwise well formed teeth, spots of various sizes and color, small blind holes, projections and depressions, furrows and corrugations. And while some teeth have patches of the crown devoid of enamel, others have patches of enamel on the cervical border, and even on the roots. (Figs. 5 and 6.) Those organs which have undergone a change in their

FIG. 5.

FIG. 6.

form after their complete development, and have become joined with adjacent organs, have undergone a pathological process, and, accordingly, must be considered as pathological products; such is a cicatrized surface, the result of previous injuries, and the coalescence or fusion of the roots of two teeth in consequence of previous inflammation or disturbance. Thus we must consider that when teeth previously separate in their germs or follicles, subsequently become joined to their neighbors, owing to a non-development or absorption of the dental septa, the union is a pathological process of simple fusion. And when teeth become connected, either wholly or in part, during their inceptive development by a process of intimate union, such union cannot be viewed in any other light than that of a process of physiological confusion. Now, the roots of *individual* teeth present the greatest number of examples of *confusion;* since, while growing, the external posterior roots of the superior molars are frequently united with the internal or palate roots of the same tooth, and the same phenomena occur with the anterior and posterior roots of the inferior molars, whereas the *fusion* of divided roots is very rare, and can only take place when they are very near each other, either in their entire length or at their extreme points, or when the intermediate root-septum is either absorbed or is concreted with them. Fusion of two molars can take place in the fangs only, as in Fig. 7; for owing to the interval of time in the development of such teeth *confusion is impossible.* How is it possible for a six-year molar crown to be confused with a twelve-year molar crown; or a twelve-year molar crown to be confused with a *dens sapientia*, which usually appears twelve years later in life?

FIG. 7.

Supernumerary teeth may become confused with true molars, or with a bicuspid; but *only* under the supposition that nature has provided a common primary cell for two germs would the confusion of the crowns and fangs of two molars be possible; for the confusion of the crowns would have to take place in the germs before the enamel organ became crystalized. Lateral incisors, or canines and bicuspids of the superior set, never become fused or confused with each other, for the following reasons: The germs of the canines originate in the maxillary

bone proper, and the sutures of the intermaxillary interpose a barrier between the germs of the lateral incisors and the canines; so it is with the two central incisors of both jaws; the median suture forbids the union of these teeth either by fusion or confusion. Now the canines and first bicuspids of either jaw have not the same barrier to prevent their union, yet there are reasons equally as strong for their not becoming united. The great individuality of the canines, their length of roots, the distance they are placed in their germinal state from their neighbors, render their conjunction with their neighbors, if not impossible, at least very improbable. On the other hand, one front and lateral incisor may be *confused* together (Fig. 8), but never *fused* together as in the molars, and in such cases a longitudinal depression will indicate the manner in which the germs were united. The incisors of the first set are more frequently found confused than their representatives of the second set; but all the other teeth of the second are more frequently found united than canines or molars of the first set.

FIG. 8.

The bicuspids of the permanent set, in very rare instances, have been found confused, but never conjoined at their fangs by the pathological process of fusion. If there should be any doubts as to the possibility of the dentine of a true molar becoming a capsule for a supernumerary tooth, Figs. 9 and 10 will remove such doubts beyond all controversy. In the vertical section of Fig. 9 the encysted supernumerary is seen to be devoid of enamel and is partially fused to the internal surface of the tooth. In Fig. 10 the dentine of the supernumerary is fused to the anterior surface of the posterior root, the enameled cusped crown directed forwards and upwards, forming a cyst of the anterior root at its bifurcation with the posterior root; the pulp-cavity of this tooth has not been entered by the supernumerary, but the

FIG. 9.
Section of superior right second molar, showing encysted supernumerary.

a. FIG. 10. *b.*
INFERIOR *dens sapientia.*
a. Section, showing enamel cusped crown and compressed pulp cavity. *b.* Anterior fangs, distended, forming cyst at the cervical portion of the crown and into the pulp cavity.

inferior walls of the cavity appear to have been distended upwards and outwards, lessening the size of the pulp-cavity.

The roots of the teeth in the human subject are sometimes more, but frequently less than the normal standard, and when deficiency in number occurs it is found in the conjoined roots of the molars.

a. FIG. 11. *b.*

Those teeth which have more roots than the prevailing number are provided with accessory cells to receive the accessory radicles in the alveolar process.

The superior molars have sometimes four and sometimes five radicles. (Figs. 11 *a* and *b.*)

The first superior bicuspids are usually provided with two roots connate, but with two separate canals, frequently with two roots separate, and sometimes three; when with three, two are placed externally as in the molars of the same series. (Figs. 12, *a* and *b.*) (Fig. 13.)

The second superior bicuspids have but one root and but one canal; sometimes two roots connate, but never entirely separated.

a. FIG. 12. *b.* FIG. 13.

Canines may be often found with two roots connate and two canals, seldom with two roots separate their whole length; and sometimes they carry delicate rootlets.

The inferior molars usually have two roots, one anterior and one posterior; these roots are flattened from the anterior to the posterior, and in a majority of cases it will be observed that each root of these molars has a longitudinal depression or groove, indicating that each root is in reality two roots connate; and what is true of the external surface of these roots is also true of the internal, they will be found to have two canals more or less united. Sometimes the posterior root is divided, forming two roots, but this is seldom or never the case with the anterior root.

The front and lateral incisors very rarely carry rootlets.

Now, in regard to the relative proportion that the crowns of teeth bear to their roots, it will be found, as a rule, that teeth

with very long or very large crowns have very short roots, while teeth that have very low or very short crowns have very long roots, and it is rarely that the proportion between the crown and the roots is well sustained; therefore, in shifting such teeth, care should be observed, for as these teeth with long roots and short crowns will require much time to place them in a new position, on account of their deep cells and the small leverage the crown affords, so, likewise, greater care and more time will be required in moving teeth with short roots possessing long crowns; for with the greater leverage of the crown over the short root such teeth are easily lifted out of their cells, which should never be done in regulating teeth, or, if done at all, done but slightly. In some subjects the crowns of the teeth are found to be exceedingly strong and arched, and in others where they should be arched they are depressed. On the crowns of some teeth there may be seen an indefinite number of cusps, and the crowns of others are curved and deformed in many ways; but deformities and curvatures are much more frequently seen at the dental roots than at the crowns. In some subjects the teeth are so closely arranged that some of their number are crowded more or less out of the arch, and the reason why such teeth of the superior maxillary appear more frequently on the exterior than on the interior of the arch is partly owing to the natural inclination outwards of the superior set, and the flexible thin external wall of the alveolar process, which offers little resistance to the developing tooth. If, however, the developing tooth should have an inclination inwards, it must penetrate the internal strong wall, which is reinforced by the palate process, and which offers a barrier that, in many cases, it can not remove. (Fig. 14.) This thick firm wall is the reason why the teeth which take

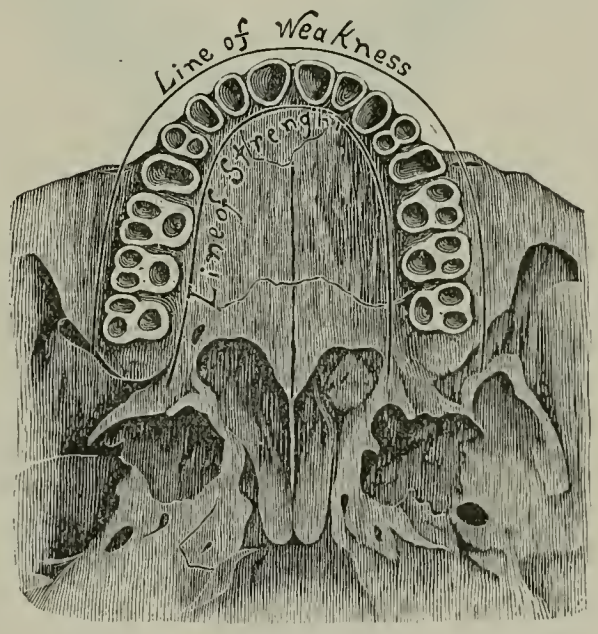

FIG. 14.

this direction appear later in life than those which break through the external wall. The canine teeth of the superior set, for example, usually break through the external thin wall and appear from the eleventh to the twelfth year; if, however, their course is directed to the internal thick wall their appearance is delayed to the eighteenth or twentieth year, and sometimes they are lost in the substance of the bone and never appear, as is also the case with the inferior wisdom teeth; or they may only become visible in very old age when the bone becomes absorbed. In the inferior set, however, the molar teeth have an inward inclination, owing to the internal thin wall and the external thick wall, which is reinforced in this region by the external oblique ridge. The external wall of this process, commencing with the right second bicuspid and extending round and ending with the left second bicuspid, is thinner and consequently weaker than the internal plate or wall of the same region; it therefore follows that the line of strength and weakness intersect each other at the site of the second bicuspids* of the inferior maxillary. (Fig. 15.) From this it will appear that numerical deficiency is mostly due to delayed development or obstructed appearance, and not actual absence of individual teeth. Observation shows that irregularities of position of the teeth occur in either maxillary, or in both at the same time; but such irregularities occur more frequently in the superior than in the inferior set, and oftener with the anterior than with

FIG. 15.

* A fracture of the lower jaw is usually in this region, and the fracture is generally at the expense of the outer portion of the anterior and the inner portion of the posterior fragment; this is owing to the great depth of the cells of the canines and bicuspids, the mental foramen and the natural oblique division of the bone in this region, rendering the bone weak at this point. An undeveloped *dens sapientia* lodged at the base of the coronoid process is also an element of weakness at the angle of the jaw. In the extraction of teeth from either jaw they should always be inclined toward the line of weakness.

the posterior teeth. The variations in the forms of the teeth, which in early youth are not fully developed, the shape of which undergoes change by later development by a progressive physiological metamorphosis, and those changes in organic structure which take place by a retrogressive physiological metamorphosis, will not be considered in this connection; neither will a special description of a regular set of teeth be given, either of the deciduous or permanent set, but a general description of both with the alveolar process, as being more pertinent to the subject under consideration. The deciduous teeth are of three kinds: incisors, canines and molars. The eight deciduous incisors, while they resemble their successors, are altogether narrower, shorter, thinner, and more scalpriform in their character than their representatives of the second set.

The four canine teeth of the first set are replaced by the four canines of the second, which are longer, thicker, and more angular than those of the first. The eight deciduous molars, with their double and triple roots, are replaced by eight conical or bicuspid teeth, with longer and, in most cases, single roots and with smaller and rounder crowns. These buccal teeth supply in children the place of the molars in the adult, and nature has formed their crowns accordingly, although on a much smaller scale, with this difference, however, that among the molars of the superior as well as the inferior maxillaries of the adult the first molar is always the largest, while with the deciduous molars the first one is constantly the smallest; and in so far as the successors of the deciduous molars are concerned they are nearly of equal size, but always smaller than their predecessors. Thus we have twenty teeth in the maxillaries of a child from three to six years of age; before three years they are not all present, and later they begin to be replaced by the permanent set.

The deciduous teeth, on account of their soft and porous nature, are readily permeated by injurious fluids, and are, therefore, subject to early destruction; and since these teeth have much larger pulp-cavities in proportion to their size than the teeth of the permanent set, and these cavities enclosed by soft, bony walls, which are easily destroyed, it can readily be seen why the deciduous, especially the molars, are often, in the first year of their appearance, so easily attacked by caries and destroyed. The

porous and moist nature of these teeth renders them subject to a wet caries, and not having far to penetrate it soon exposes the pulp-cavity. When the pulp of a deciduous tooth is exposed it may be destroyed, but it cannot successfully be removed and filled, as in the case of a permanent tooth; for if this is done the filling will prevent the constant flow of ichorous fluid which is always present in such teeth, and instead of escaping by way of the carious opening it will force its way through and permeate the spongy bone of the alveolar, and may destroy the cell-walls of several deciduous teeth.

Furthermore, when we consider that the dental root septa of the deciduous molars are immediately situated between the fangs, forming a pad of spongy bone between the cusps of the half-formed bicuspids and the bifurcation of the fangs of the molars, and that the pulp-cavity is very thin at the bifurcation of these fangs, and is the first point to be absorbed, it will be seen that when the spongy septa, that separate the deciduous from the permanent teeth, become infiltrated with ichorous fluid, the cusps of the permanent teeth may not only be discolored, but partially or wholly destroyed; these pathological conditions occur more frequently in the lower than in the upper maxillary, owing to the attraction of gravitation.

Now, the maxillaries of children are full of cavities and soft walls in which purulent matter finds easy ingress, whereby subsequent destruction is more likely to take place than in the same bones of the adult. The neglect to extract such teeth, either by ill-timed parental affection, or a misconception of the anatomical and pathological condition of the parts, is the cause of some persons never having all their permanent teeth during their lives in the region of the deciduous teeth, and why others have teeth with defective enamel. All the other deciduous teeth of the superior and inferior maxillaries have undivided primary cells, and are therefore less liable to destruction than the molars, which have dental root septa dividing the primary cells. If, however, the several deciduous teeth can be retained until the periods of the eruption of their several successors, without detriment to the child's health, many tendencies to irregularities may be prevented; for if a sound deciduous tooth is extracted several years before the time of its successor's appearance, which unfortunately is

sometimes done to relieve the crowded condition of the already erupted permanent incisors, then the cell of the extracted deciduous tooth will fill up with osseous matter, and since the succeeding tooth cannot penetrate through such a bony cicatrix it will find its way through the external or internal wall of the alveoli, and appear outside or inside the dental arch, if it appear at all. (Fig. 16.) Sometimes such retarded teeth do not appear until extreme old age, when the alveoli have absorbed and exposed them to view. Again, if sound deciduous teeth are permitted to remain beyond the period of their natural dissolution the same deplorable condition of the second set will be realized, for the theory of the roots of deciduous teeth serving as guides for their successors is not well founded, for the following reasons: A perfect deciduous tooth can only be obtained from a healthy child between the age of four and five years, one year earlier the root ends are not completely developed, and one year later the ends begin to be exuviated.* When the first set of teeth is forming, the cells, cell septa, and dental septa are formed with them; in a word, they bring up their own process, and when the evolution of the tooth is completed a physiological process of exuviation sets in, which gradually sweeps away the process with the teeth, whence come larger teeth,

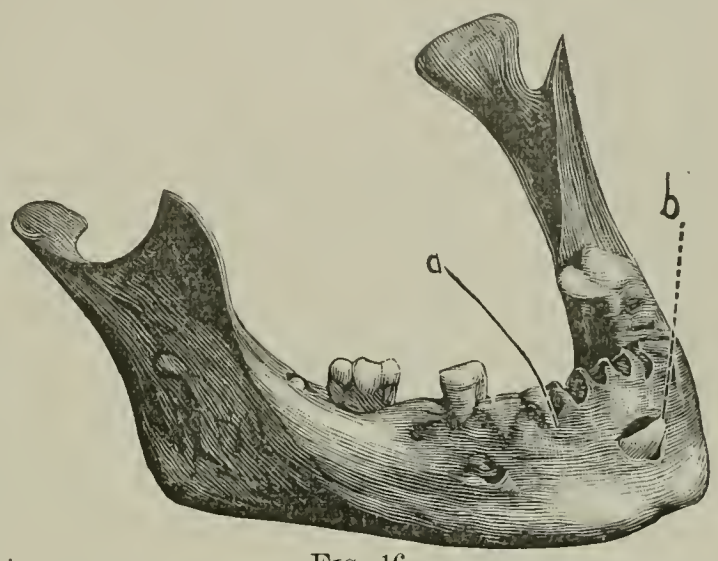

FIG. 16.

a. Cicatrix at the site of the deciduous cell. The deciduous cell filled with osseous matter after the removal of the deciduous tooth, and did not exuviate with the rest of the deciduous process, but formed a cicatrix which the permanent canine, *b*, could not penetrate; this barrier forced the growing canine to the weakest point of egress.

* In this connection I prefer the word "exuviated" to that of absorbed, as more expressive of the physiological conditions under consideration. Absorption may be either external or internal; may be either absorption of decomposition, or absorption of composition, whereas the word "exuviation" needs no paraphrase, but expresses in one word the physiological process by which animals cast off, at certain periods of their growth, the tissues that have served a purpose, preliminary to renewal. Thus animals shed their hair, birds their feathers, deer their horns, lobsters, crabs, and crustaceans in general their shells, and all mammals their first set of teeth, by a physiological process of exuviation in contradistinction to the pathological process of exfoliation.

accompanied by a larger process, and the jaws are correspondingly larger. When we consider the manner in which a tooth is evolved, the belief in the "resorbed ossific tissue of a deciduous tooth performing an important part in elaborating the second dentition must be considerably weakened." It has been long established that the development of dentine is by *centripetal calcification*. A tooth, when fully formed, is subject to decay, but has no inherent power of reparation. A tooth of limited growth* can only increase in size, after its formation is completed, by abnormal growth of its most highly organized constituent, the *cementum*. And, further, no effete material can be resorbed without producing deleterious effects on the system. This pleasing thought, that the deciduous teeth are worked over by the hand of niggard nature in the spirit of affectionate frugality, for the benefit of the permanent set, finds its parallel in the belief that the bear grows fat in the hibernating season by the simple operation of sucking his paws.† Such notions only serve to illustrate the theories advanced from time to time in mechanics, and the many phenomena presented in the cycle of life, that something can come from nothing. That which concerns us the most as guides in practice is the facts in every given case, not whether the facts are pretty; for so long as suffering humanity look to us to relieve them of maladies, sentimentality or belief will be but a poor substitute for a knowledge of laws that govern the universe.

In the regulation of irregular teeth there are many factors to be considered; for, inasmuch as a living tooth cannot be moved without moving something else, an intimate knowledge, not only of the forms of the teeth but their surroundings, both in the living body and the skeleton, is absolutely necessary. For in shifting a tooth the relation of the parts becomes changed, and success will depend upon the activity of the tissues to heal and repair injury; and this will depend upon the special vigor of the patient and the extent of the surface injured, as much as upon the means employed. Now, since an accurate knowledge of the osseous formations which embrace the roots of the teeth is of great importance to the operator, I will describe them as they appear in

* In the incisor teeth of rodents, in which the formative pulp is persistent, the teeth are unlimited in their growth, and the pulps are always found in a full progressive activity up to the time of the rodent's death, and these teeth are not preceded by deciduous teeth.

† The truth is the bear grows thinner every day he stays in his hibernating condition.

the sections I have made for that purpose, and from the best authorities I can find, giving the substance of their description or classification rather than their words.* For every tooth implanted in the the superior or inferior maxillary there is to be found a more or less funnel-shaped cavity, which is surrounded by thin and compact bony walls; this cavity is the tooth cell. Each of these cells begins on the extreme margin of the alveolar process, circular in form, adapted to the form of the tooth, a little below the termination of the enamel; this is the *primary* entrance, gradually it becomes smaller, and ends by an almost closed point, in a more or less vertical direction. If such a cell is divided into several portions, as in the molars, there will be a ring-shaped primary entrance from one to one and a half lines deep; within this entrance there begin secondary entrances, which extend and terminate in isolated funnel-shaped cells; each cell is for the reception of a tooth, whether it has one or more roots, and therefore they are named primary cells. These cells are either divided into several sections, or they are undivided; the first are called divided cells; the second, undivided cells. To the former belong the cells that receive the molars of the superior and inferior maxillaries, and to the latter belong the residue, which are single and receive the roots of those teeth that generally have but one root. Now, as a general rule, the divided cells of the superior maxillary are formed into three, by a wall projected from the posterior to the anterior, and another projected from the external internally to the posterior anterior projected wall. (Fig. 14.) Whereas each divided cell of the inferior maxillary is divided by one wall running from the external to the internal, dividing it into two cells. (Fig. 15.) These cells receive the roots of the molars

* Odontography: or, a Treatise on the Comparative Anatomy of the Teeth; their Physiological Relations, Mode of Development and Microscopic Structure in the Vertebrate Animals. By Richard Owen, F.R.S. In two volumes, one of Text, and one of Plates. London, 1845.

Since the first publication of this work there has been no work written on any of the branches embraced under the head of anatomy that is of any importance, in any language, that either directly or indirectly treats of the teeth, but that has been compelled to refer to Richard Owen—and why this work has not been included in the list of text books to be used in dental colleges is a question for those who are *deeply interested in dental education to decide.* From the time of John Hunter to the present there has been no work on the anatomy of the human mouth and teeth superior to the work of Dr. Georg Carabelli. He is not mentioned in any English work on the teeth, excepting in the work of Carl Wedl M.D., in his Dental Pathology. Kölliker in his Manual of Microscopical Anatomy, at the close of the chapter on the teeth, in giving the literature of the subject, makes no mention of Carabelli. I take this opportunity to present his name to the profession as one of the great original workers in the science of anatomy, and particularly in that branch of anatomy that relates to our specialty. Dr. Georg Carabelli was a surgeon in the Austrian army, and flourished during the early part of the present century. His work on the "Anatomy of the Human Mouth" was published at Vienna in 1844, in two volumes, one of Text and one of Plates. They have both been freely used in subsequent works.

that are implanted in them, and since they are the final ends of the primary cells they are named *filial cells.*

All exceptionally formed cells, as for example, a cell for a fourth or fifth root of an upper molar, for a third or fourth of an inferior molar, or for a double root of a bicuspid, are named *fortuitous filial cells.* The interspaces between the tooth cells are filled with cancellated bone which holds them together, and in which, as it were, the cells are implanted. The interstices of this cancellated bone give protection to the nutrient vessels that supply the teeth, process and soft tissues by which they are surrounded. By this spongy bone each primary cell, immediately at its entrance, is bound from the anterior to the posterior part of its adjacent cell. Thus two cell-walls come into coalescence and form a more or less double wall, which is always found to separate two cells from each other, therefore they are called *dental septa.* (Fig. 17.) This septum projects one-half, and sometimes one whole line above the external and internal cell margin, fills the space between two teeth, and serves to keep the teeth equally apart and firm in their places.

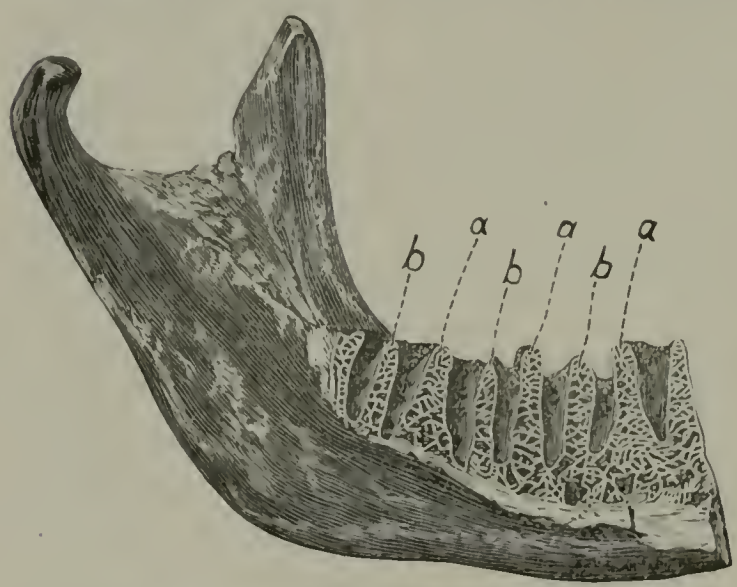

FIG. 17.

Vertical, internal lateral section of the lower jaw, showing the construction of the alveoli from the second bicuspid to the third molar. *a a a*, Dental septa. *b b b*, Dental root septa.

All dental septa are at the base thicker than at the free projecting margin. The free margin of the dental septa adjusts itself, partly to the diameter of the adjacent tooth roots and partly to the distance between them. Thus the septa between the four dental cells of the superior incisor teeth, in relation to the width of the tooth crowns, are not so thick as those of the corresponding cells of the inferior, for the reason that the roots in the superior are very thick, and, therefore, so close together that only a thin wall

can find place; while in the lower incisors the roots are depressed laterally, and their widest diameter, being crossed by their crowns, leaves a greater space which is filled by a thicker septum; and, finally, the cell-walls which separate the filial cells are also spongy, not double, and much lower than the dental cells, and since they only separate the filial cells of the roots of the same tooth they are called *dental root septa.* (Fig. 17.) Now, in teeth that are unusually distant from each other, or in teeth in which the cervical portion is small in comparison to the crown, the *dental septa* will be proportionately stronger and thicker, and will increase the difficulty of moving a tooth laterally, in the case of the front teeth, or anteriorly or posteriorly in the case of the back teeth; and this applies equally to the superior and inferior maxillaries. Teeth that are on the outside of the arch of the superior set require more continued force to move them inwards than the same teeth, if they were inside, would require to move them to the outside of the arch; for the outside of the arch of the superior maxillary process is the weaker, whereas the inside is reinforced by the palate process, which gives it a greater power of resistance. The conditions are different in the inferior maxillary, as I have already explained. As neither the crowns nor the fangs of teeth have a regular shape in their circumference, and the anterior six are biconical in their greatest length, it is easily seen how small an obstacle will turn them from their regular course, and as the form is more favorable for such a divergence in the front teeth than in the back we accordingly find irregularities more frequent in this region.

Now, as there are no two cases of irregularities exactly alike, and as the circumstances surrounding each case are not the same, it would be impossible to lay down rules to govern their treatment. The cases which are constantly presented for treatment are as complex in their character, and as difficult to reduce to rule, as the judgment and mechanical qualifications of the operator who may undertake their correction. There are, however, a few facts connected with the regulating of teeth that appear to be self evident: *First*—If a tooth can be diverted from its natural course and given an oblique direction by the mechanical forces in nature, during its development, the same forces, used with intelligence, can restore it to its natural position. *Second*—As it required time in the course of nature to produce the displacement, so it will

require time in the course of nature to induce a replacement, since the operation cannot be removed from the natural laws which control it. *Third*—As the ossification of the incisors and canines is not completed until the tenth and eleventh years, for obvious reasons it would be well enough to postpone all interference until the fourteenth or fifteenth year. If the canines and incisors are examined during the first few months of their appearance, three small cusps may be seen on the incisors, and sometimes on the canines; later these soft cusps are worn, and in one year they have nearly disappeared. *While these cusps remain, the fangs of these teeth are not completed.* It will also be observed that the deciduous teeth do not carry these cusps, for the roots of the deciduous teeth are hardly formed when elimination commences. *Fourth*—All devices or machines used for shifting teeth must be simple in their character, for the less complicated the machine is the easier it will be to understand and use. *Fifth*—The machine should be so constructed as to act on at least three points: two fixed points on the teeth that are *not* to be moved, and one on the tooth that *is* to be moved. *Sixth*—As the requirements are at least two fixed points, and one movable, if the first two cannot be obtained the machine is useless. On the other hand, if the tooth to be moved is not sufficiently developed to permit the movable point to act upon it, it is also useless. *Seventh*—As the stability of a tooth is not in proportion to its size or external appearance, two fixed points at least are necessary to insure success. *Eighth*—The real necessity of extracting teeth to correct irregularities is very rare, and, therefore the safest rule will be to observe an armed neutrality, and make the case a special study. If this rule is observed long enough the truth will finally appear, and will well repay the observer.

The mixture of races is a prolific cause of irregularity of the teeth, not only in relation to the jaws, but in relation to the individual parts of the teeth themselves. Teeth of fine proportions cannot be considered apart from the size of the bones of the face and, in fact, of the whole body. They may be symmetrical in themselves, but unsymmetrical in regard to their relationship, for a fine set of teeth in the mouth of a Caliban would only serve to intensify his repulsiveness. Now, the size of the teeth in human beings varies, and has no proportionate relation, in many cases, to the size

of the body; thus, very frequently, small persons have very large teeth, while, on the contrary, persons of colossal size may have narrow and small teeth. Large persons usually have large jaws, but the teeth do not correspond to the size of the jaws as often as the jaws correspond to the size of the body, either in large or small persons. There are large jaws with small teeth, and small jaws with large teeth; the latter occur more frequently in small persons, while the former are of rarer occurrence in large persons. This irregularity of form and development of the teeth and jaws in relation to the body does not exist in any other class of mammals, and occurs more frequently in the European and mixed races, than with the unmixed.

I have used the expression "races of men." When the word race is spoken of the European mind immediately sees the Negro, the Chinese, the Red Indian, and the Hottentot. He admits that there are people who differ from him, but not in Europe; whereas, the European race, so called, differ from each other as widely as the Negro from the Bushman, the Red Indian from the Esquimau, the Esquimau from the Peruvian, the Peruvian from the Patagonian. Asia is full of different races of men, from the cold north to the extreme south. Africa, from the cold south to the tropical north. South and North America were full of races of men long before the European knew they were in existence. *Genus homo!* Man forms but one genus, and while that genus is the only one of its order it is divided into many species. Genus is an assemblage of species, and the many species which go to make up this *genus homo* are of endless shades of color; commencing with jet-black and finishing with white, and in the whitest species the greatest mixture appears to prevail. The colored species are largely in excess, and form at least seventy-five per cent. of the whole genus. But this percentage of the dark over the white is rapidly being reduced, owing to the superior intelligence of the white. Now, the reason why naturalists assert that man forms but one genus, which is composed of many species, is that there is no physiological barrier which prevents him from crossing and recrossing without end, propogating from the very lowest of his species to the very highest; hence, it is conclusive that the whole species are homogeneous. Now, this is not the case with other classes of mammals, for while many others possess

characteristics in common, physiological barriers prevent them from crossing; hence it is that naturalists divide them into species, and sub-species, families and sub-families. Take the eighth order of mammalians (ruminantia), while all the individuals which compose it are constructed on the same plan, especially as regards the teeth, they are divided into many genera—sheep, goats, antelopes, stags, camels, llamas and oxen—which cannot intermix; the antelopes alone compose a very numerous genus, consisting of over seventy well defined species, which do not even cross with each other; and it is the same with the cats, a numerous genus of the third order (carnaria), tiger, lion, leopard, lynx, puma and panther; each species retains its individuality, and is incapable of crossing, hence their teeth and jaws are regular as to form and size, in relation to the body; therefore, there are good reasons for the irregularity of the teeth in human beings, to be found in the crossing and recrossing of the many species of which they are composed.

I am under obligations to the following named gentlemen, who, recognizing the utility of a large collection of anomalous teeth, have liberally placed in my hands their own private collections, to be incorporated with my own, in order that they may be preserved for future use by the profession: Dr. W. A. Moore, Benicia, Cal.; Dr. William Day, Winchester, Ill.; Dr. G. S. Seymour, Louisville, Ky.; Dr. S. A. Campbell, Mattoon, Ill.; Drs. William H. Eames, H. J. McKellops, A. H. Fuller, G. A. Bowman, St. Louis, Mo.

CHEMISTRY.

BY WILLIAM H. TAGGART D.D.S., OF FREEPORT, ILL.

Possibly, there is no branch of the natural sciences that has more of the mysterious connected with it than chemistry. The various objects which constitute external nature present to the observer an infinite variety of quality and circumstances. Some are brittle; others are elastic and tough. Some natural objects are endowed with life; others are lifeless; they may be moved, but do not move themselves. Some bodies are in a state of

incessant change; while others are so immovable and unchangeable that they seem to be everlasting. In the midst of this diversity of external objects, where lies the domain of chemistry.

When air moves in wind, when water moves in tides, or in the fall of rain or snow, the air and the water remain air and water still; their constitution is not changed by the motion, however frequent or however great. A bit of granite thrown off from the ledge by frost, is still a bit of granite, and no new or altered thing. If a solid bit of iron be reduced to filings, each finest morsel is metallic iron still, of the same substance as the original piece, as will appear if a piece be sufficiently magnified under the microscope. The melted fluid lead in the hot crucible and the solid lead of the cold bullet cast from it are the same in substance, only differing in respect to temperature. In all these cases the changes are external and non-essential; not intimate and constitutional. They are called physical changes, and do not change the composition of the molecules, and, therefore, do not change the nature of the substance acted upon.

When iron is exposed to the weather it becomes covered with a brownish coating, which bears no resemblance to the original iron, and if exposed long enough the metal completely disappears, being changed into this very different substance, rust. So, too, the fragment of granite broken from the ledge, exposed for centuries to the action of air and rain, becomes changed, and after a time could not be recognized as granite. All these changes involve alterations in the intimate constitution of the bodies which undergo them; they are called "chemical changes," and do affect the nature of the substance.

To show, in a single experiment, a physical and a chemical change, I have made a solution of calcium chloride in water, which makes simply a physical change; I pour with it a small quantity of sulphuric acid, another physical change, for it simply divides the acid; but the moment the two substances unite we have a complete change in the nature of the substance, or chemical change, and, as you see, the two transparent fluids are changed into a white solid, and have formed a substance in which you can neither recognize calcium chloride or sulphuric acid.

Mixtures of two or more substances may be formed by mingling them in all conceivable proportions, but a compound formed

by chemical action consists of certain invariable proportions of its constituents. Thus, oxygen and hydrogen may be mixed in any desired proportions, but they will unite to form water only in the ratio of one part oxygen to two parts hydrogen. When iron rusts, the oxygen of the air combines with the metal at the rate of three ounces of oxygen to seven ounces of iron. No chemist can make three ounces of oxygen unite with six ounces of iron. In a mixture the constituents are said to be free; in a compound they are said to be in combination.

Possibly, a greater proportion of our success as dentists, in treating the cases as presented to us, comes from thorough cleanliness. Another large item of our success lies in the cleanliness of our offices and persons, and as water is the type of cleanliness, it may not be out of place to show the composition of this most abundant and useful article; at the same time this will show you what is meant by the chemical symbols. In the first place we will take the water, and ask of what it is composed. In this case I shall use electricity as the key to open it up. By means of electricity the chemist is enabled to decompose almost every known compound. I have here an ordinary bichromate potash battery, the poles of which are connected with this vessel containing water, with a few drops of acid added to make it a better conductor of electricity; over the poles of this battery I place two test tubes, to collect what is given off. [Experiment.] You see that one pole has generated twice as much gas as the other. Now, if I take this larger volume of gas and place a lighted match in it, the light is immediately extinguished, showing that the gas will not support combustion, but it takes fire and burns itself, showing that it is different from air. [Experiment.] This gas has been named hydrogen. The other gas, if treated the same way, not only supports combustion, but increases the flame, showing it to be different from air and the other gas H, and one volume only was formed to two volumes of the H, showing the composition of water to be H_2O. This decomposition was produced by what is called "electrolysis." Now, if we can form water again out of these two gases, it will be conclusive proof that this is the composition of water. If these two gases were mixed together again and ignited, we would have a violent chemical combination followed by a loud report, and a drop of water would be the result.

This can be shown in a crude way by burning H in the air as in this experiment. I form the H gas and light the small flame, and over this hold a glass tube; the musical tone made is caused by minute explosions as the hydrogen unites with the oxygen of the air, and you see the tube is covered with moisture, and a drop of water forms.

As water is composed of H_2O, it is a very easy transition to come to that much talked of compound peroxide of hydrogen, which has for a symbol H_2O_2, or one more atom of O, or in other words oxygenated water. This substance in the pure state is a syrupy liquid, having a disagreeable metallic taste, somewhat resembling tartar emetic. When taken into the mouth it causes a tingling sensation, increases the flow of saliva and bleaches the tissues with which it comes in contact. It is a very unstable compound, and even at ordinary temperatures is decomposed. The dilute substance, as we use it, is, however, more stable and can be boiled, and even distilled without suffering decomposition. Substances containing sulphur are decomposed by it at the expense of half its O. Its therapeutical action in the treatment of alveolar abscess has been explained in this way: "When the peroxide of hydrogen comes in contact with pus the extra O it contains is liberated so rapidly that the hydrogen and sulphur of the tissues immediately combine with it, resulting in H_2SO_4 or sulphuric acid in small quantity, sufficient to glaze the surface of the pus producing area, thus affording an opportunity for the exuding protoplasmic material to organize into new tissue. The remaining unsatisfied atoms of O quickly distend the pus sac and force the contents through the root or fistulous opening."—(*Harlan.*)

To show that these chemical changes do take place, I have made some sulphureted hydrogen (H_2S), the principal disagreeable substance found in pus or in the decomposition of albuminous substances, and to this I add the peroxide of hydrogen H_2O_2, and test the product formed, and find it to be sulphuric acid. [Experiment.]

While we are on this subject of remedies for alveolar abscess, it may be a very good time to speak of carbolic acid, our old stand-by. This substance is made from coal tar, and is a more agreeable antiseptic than creasote. That there is a chemical difference between them can be easily shown, and for those who

are anxious to know for certain which they are using (as the one is so often sold for the other), the test can be made in a few minutes:

First—Carbolic acid is soluble in glycerine; creasote is not.

Second—Carbolic acid precipitates nitro cellulose from collodion; creasote does not.

Third—Carbolic acid gives a brown color with ferric chloride and alcohol; creasote gives a green color with ferric chloride and alcohol.

Fourth—Carbolic acid gives a violet color with ferric chloride and water; creasote gives a green color with ferric chloride and water.

Carbolic acid coagulates albumen, and as albumen is one of the principal ingredients of pus it is a question whether the wholesale use of carbolic acid in these cases is admissable, especially when the pus is forming. Just the fact that the case gets along well by using it, is not always proof positive that the proper medicinal remedy has been used; for the same case, treated with a remedy that would not coagulate the pus, might have got along much better, and there would not have been the insoluble compound formed for nature to remove by absorption; in other words, the simple pus would be easier to absorb than the insoluble coagulated pus. Let those who have implicit faith in the action of these remedies (carbolic acid and creasote) in all cases, try treating their next case of alveolar abscess by simply going through the same process with water, and they will be surprised at their success, and will come to the conclusion that success in the treatment of alveolar abscess comes in a great measure from persistent *mechanical* cleanliness.

In using either of these two remedies in the cases mentioned, the object is said to be to disinfect the tooth. Now a disinfectant is a smell destroyer, and these two substances are disinfectants only in a very small degree, and that small degree is due more to the mechanical removal of the decomposed mass than to any chemical combination caused by the remedies. To show that carbolic acid is not a true disinfectant, we have simply to place it in contact with the most disagreeable odor we have to remove, which is sulphureted hydrogen. I have here some water saturated with this offensive gas; now, by adding the carbolic acid, even in excess, we have no diminution of the smell, simply for the reason

there has been no chemical change. If I now add chloride of zinc to the same kind of a solution a chemical change takes place, and the smell is destroyed, showing the proper action of a disinfectant. [Experiment.]

To show this chemical change I form the equation $H_2S+ZnCl_2=ZnS+2\ HCl$. In this change the chlorine, which always has a great affinity for hydrogen, has united with it, and thus broken up the compound, destroyed the smell, and formed hydrochloric acid, 2 HCl.

There are a great many in the profession who cry down amalgam fillings, not because they think they will not save teeth, but because they say that the mercury they contain has an injurious effect on the health of the patient. For the benefit of those who take this ground, and the fact that it comes legitimately under the head of chemistry, I have here a very delicate test for the presence of mercury, either free or in combination with metals, as we find it in amalgam. By taking a solution of nitrate silver and adding ammonia until it becomes cloudy, and then adding enough more to make a clear solution, and using this as an ink to write with, and placing the paper over the amalgam plug and allowing it to remain in the dark the writing turns dark, showing that the mercury is constantly giving off fumes. I have performed this experiment with an amalgam plug that was in a tooth 42 years, and it apparently gives the test as well as a younger one, and the beauty of it all is that the patient's health was not destroyed.

Another of our common remedies, that has a few interesting chemical thoughts connected with it, is arsenic. This is a remedy that does not lose its identity very readily; in other words, it remains as arsenic, I suppose, for an indefinite period, and may be detected as a poison months and even years after it has been used. I have here a solution made from the pulp of a tooth destroyed by arsenic; the remedy was allowed to remain in the tooth two weeks. I have very carefully followed the rule for detecting arsenic by Marsh's test; that is, by testing the purity of the zinc and acid to find that no arsenic was present to begin with. Now, by pouring the solution containing the pulp into the bottle where nascent hydrogen has access to it and passing it through chloride of calcium to absorb all moisture, and by burning the gas, we have formed on a piece of cold porcelain held in the flame a

characteristic black sooty deposit. [Experiment.] This is a very delicate test and accurate, for we cannot get this same kind of a spot from any other substance that we can use. It is said that the one seven-thousandth of a grain can be detected. This test was performed with the small end of the pulp, showing that the arsenic was absorbed into the pulp and was not merely on the surface, as some say. To show the destructive effects which arsenic has, and to show what might come from the careless use of this remedy, I have here a piece of the process from around the roots of a lower molar, the death of which was caused by the careless use of arsenic. It seems the patient, a young lad sixteen years old, went to a dentist to have an aching tooth extracted. The dentist pulled the crown off, leaving the pulp entirely exposed and the roots still in their place; of course it ached fearfully, and the boy was afraid to have it touched with the forceps again, so the dentist said he would destroy the nerve by putting medicine on it, so he put arsenic directly on the exposed pulp and bleeding gum without any precaution whatever. In the course of a few days the face commenced to swell and the patient fell into my hands, and a worse gangrenous looking mass could hardly be imagined than that presented by looking into his mouth. In the course of a week the gum had all sloughed off that side of the jaw, and the process around the broken tooth and the adjacent ones began to come away in pieces. This piece I show you was the largest one, and was the process from around the broken tooth. Immediately after the patient came into my hands I took as much of the diseased parts as I could get, and made the test as just shown, and found arsenic. This shows conclusively that the remedy used was arsenic, and it also shows the results that may follow its careless use.

It is a well-known fact that the manufacturers of the zinc preparations seem to persist in sending out twice as much powder as is necessary for the liquid. For the benefit of those who wish to utilize their extra powder, I think it proper to tell how to make the oxyphosphates. The liquid is phosphoric acid. This is made by the action of sulphuric acid on old bones or by burning phosphorus in oxygen. The kind used for the cement preparations is called glacial phosphoric acid, and can be bought at any drug store (it is a solid), and by adding sufficient water to dissolve it, and evaporating this until it is of the consistency of glycerine, we have an

excellent liquid that will go with any of the powders. The powder is made from oxide zinc bought at the drug store, and by calcining it at a white heat for two hours and then grinding it in a mortar we have an excellent powder. Some manufacturers put borax, silica and powdered glass in before calcining it; and the addition of these ingredients and the difference in the burning is what makes one cement work differently from another.

DISCUSSION.

Opened by Dr. E. S. TALBOT of Chicago.

Chemistry, to the majority, is a dry subject, and, unless taught by an interesting and enthusiastic person, is difficult of comprehension. It bears the same relation to medicine as the classics do to literature; without constant practice it becomes a thing of the past. The necessity of thoroughly mastering the subject is apparent, as without it scarcely any progress can be made in our specialty. We are indebted to the essayist for bringing this question before our Society. The elementary experiments will have to be omitted in our discussion to give time for those more important to us. The essayist states that carbolic acid is a smell destroyer. This depends on the conditions under which it is applied. By adding carbolic acid to sulphureted hydrogen it produces no effect; but by applying it to a putrefying substance the gases are prevented from forming by the coagulation of the albumen.

DR. TAGGART: I said a *disinfectant* was a smell destroyer.

DR. TALBOT: We recall, during the rage of cholera in New Orleans, the scattering of carbolic acid through the streets, under the impression of purifying the atmosphere. The germ of course was not affected. The distinction between creasote and carbolic acid should be understood thoroughly by dentists, each having its place in practice. A tissue which we wish to preserve should not be destroyed by carbolic acid, nor should we apply creasote to the roots of teeth where we would prevent decomposition of tissue. The experiments with chloride of zinc are of the utmost importance, proving that though other materials may make good fillings for roots the oxychloride of zinc surpasses them. However particular we may be in removing the pulps of teeth some animal matter will remain, and with gold, gutta-percha, chloroform, etc., we have only a mechanical application, while with oxy-chlo-zinc we have a

chemical as well as a mechanical stopping thus: $H_2S+ZnCl_2=ZnS+2\ HCl$ (sulphureted hydrogen plus chloride of zinc equals sulphide of zinc plus hydro-chloric acid).

It has been stated that the peroxide of hydrogen acts as a disinfectant and antiseptic. I can not express an opinion, as I have been unable to make experiments. Marsh's test for arsenic in the pulp is both interesting and important to us. It is a fact that arsenic taken into the stomach or applied to a tissue affects it only by its presence, and the tissue is affected, only where it is applied, by over stimulation. It can only be absorbed when in a liquid state, and when the circulation of the pulp is normal. We shall all appreciate the formula for making the phosphate of zinc. I have tried frequently to prepare it, but could not succeed in hardening it. We have been in the position spoken of by the essayist, and now shall be able to manufacture our own liquid. It seems proper, at this time, to review the acid theory of decay as presented by our friend, Dr. Watt. I propose to show the fallacy of the theory demonstrated by his own statements. His article in the *Ohio Dental Journal*, of September, 1882, page 410, says: "According to my own observation when the buccal fluids present a decidedly alkaline reaction this is generally owing to the presence of ammonia, hence I regard this condition as an ordinary precursor of white decay. Even in the absence of test papers the approach of this state may be recognized by a tenacious or soapy state of the fluid of the mouth." Professor Spalding, in a paper read three years ago before this Society, called attention to the fact that this condition existed in mouths where the most rapid decay was found. I have made many observations in this direction, and can agree with him. On page 411, Dr. Watt says: "Nitric acid, formed by the oxidation of ammonia within the mouth, is, of course, taken up by combination, atom by atom, as fast as formed; hence, we need not search for free nitric acid in the buccal fluids in order to explain a variety of caries, having this acid as its exciting cause; and if even we could so find it, we would find it corroding the surfaces of the teeth, rather than making carious cavities. But though we do not find nitric acid, we may readily find nitrates." It is possible for the lungs to give off ammonia in cases of uræmia; but find it in no other condition of the system, except in

the decomposition of nitrogenous substances in the mouth—like gases given off from decomposed food lodged between the teeth. In Ginelin's "Hand-Book of Chemistry" I find the following: "Azotized organic matters exposed to the air, in contact with salifiable bases and water, yield salts, nitric acid—*the base may even be ammonia.* The predisposing affinity of the base for nitric acid causes the nitrogen, at the moment when it is set free by the decomposition of the organic matter, and before it has assumed the gaseous form in its nascent state, to unite with the oxygen of the air and form nitric acid." Now, the ammonia is the base, and the predisposing affinity for the nitric acid would cause a union of the two thus: $NH_3+HNO_3=NH_4NO_3$—(ammonia plus nitric acid equals nitrate of ammonia.) The ammonia having a greater affinity for the acid than the tooth substance, which is neutral.

As regards black decay, Dr. Watt says: "I have as little doubt that sulphuric acid is the exciting cause, as I have of anything else in dental science. This acid is formed in the mouth by the oxidation of the sulphureted hydrogen, the results of the oxidation being sulphuric acid and water. In this way it acts on a cork, carbonizing it by taking its oxygen and hydrogen to form water, and leaving the carbon in a state of charcoal. It carbonizes the organic portions of dentine, forming animal charcoal, giving the distinctive color to black decay." Sulphureted hydrogen is formed, as is the ammonia, by the decompositon of food in and around the teeth, thus $H_2S+O_4=H_2SO_4$; but does it attack the teeth and produce the black decay? In the two bottles which I pass around, the one containing undiluted sulphuric acid has discolored the cork; while the one containing the solution of water with twenty-five per cent. sulphuric acid has no discoloration on the cork. The strength of the solution containing but twenty-five per cent of the acid is so great that it burns the tongue and yet does not discolor. How would it be possible to endure a solution strong enough to produce discoloration of the teeth? The saliva consists of 99.5 parts of water, and the H_2SO_4 has such an affinity for water that it would unite and become so diluted as to produce no effect. In order to affect the tooth substance, it is necessary to confine the full strength of the acid to a limited locality, instead of its being all over the mouth, as would be the case if acids were produced in the manner described.

ILLINOIS STATE DENTAL SOCIETY, WHAT HAS IT ACCOMPLISHED?

BY DR. C. R. E. KOCH OF CHICAGO.

While at Decatur in the early part of this year, in attendance upon a reunion of veterans of the late unpleasantness, in company with our venerable but loquacious warrior brother, I had listened to him for hours while he related "his most disastrous chances of moving accident by floods and field, of hair-breadth 'scapes in the imminent deadly breach, etc.; in other words, while he was engaged in the charming occupation of swapping lies with other heroes of those same memorable days. In all of this your energetic chairman of the Executive Committee seconded him. These "tales to hear" I "did seriously incline," and so I became too full for utterance—with patriotic rapture. These Philistines discovered this, and immediately proceeded to take advantage of my susceptible condition and cunningly lead me into a trap, in which, however, at this time, I am glad to have your company. They represented how lazy I had been; how our professional country, this Society, needed the services of every son, and how it was my duty to enlist at once. Well, such reasoning I could not withstand, and I immediately signed the muster-roll. They then undertook to assign me to duty, and give me a clue as to how I could best serve you, by wearying this Society with a paper. I consented. Our microscopical warrior, beg pardon, our warrior microscopist then suggested that I take a subject that everybody knows as little about as I do. Said he: "Do as I do; give them a few glittering generalities taken from some other fellow's book, couched in your own language, and everybody will commend you for your scholarly attainments." "Yes," remarked your Executive Chairman, "look at the greatest student in our Society; he employs the same strategy; see how he treats us on 'Bacteria,' and such things, because he knows that but few can contradict him. He has gained the admiration of the members by just such a course, to such an extent that they 'caned' him at the last

session." Then our warrior spoke up, with a fervor of speech and enthusiasm flashing from his eyes: "Look at our younger friend, who has grown to be looked upon as a walking encyclopædia of 'Materia Medica;' without whose consent no new remedy can be administered to aggravate the woes of humanity; and who scientifically scrutinizes all, before it is safe for our members to employ them. He is another example of this principle. And then look at the Blattidarian, do you suppose he could have handled these innocent cockroaches in the way he did, and without fear of the wrath of the Society for the Prevention of Cruelty to Animals, had he not known that any statement he might make could not be contradicted; the methods of dining of these inhabitants of out-of-the-way places not being a matter of public notoriety, and only known to savants." This was suggested by our friend from Springfield. The veteran then observed: "You know our friend from Rockford, who once occupied our presidential chair. He posed for years as the exemplification of modesty; and it is a fact, so little did our members know of the genuine article, that they elected him only on this account, and the best part is, they have never yet discovered their delusion." "Yes; and behold our fair complexioned friend from Chicago, who was present at the birth of this Society, and has always been necessary to open its discussions. He made the members believe that he was an orator, and that no subject could be brought up on which he was not *au fait*, and could speak oracularly," remarked your Chairman. And thus a running fire was kept up of instances, to prove by the examples of our shining lights, that it was not necessary to know all about the subject treated, but only that the audience should know less about it than the writer, or what is better still, know nothing at all about it. Their arguments convinced me, and my dilemma thereby increased; I knew of no subject that would bear this test, and was seriously tempted to desert. They finally assured me that during the last five or six years this Society had added largely to its membership, and that these new members were wofully ignorant (of our early history), and that if I would write something of the nature of a history of the origin, rise, and progress of our Society, it would answer the requirements. As is customary with historians, I have given you the motives which prompted my writing and inflicting this imposition upon your patience,

and now, with your permission, we will order the curtain up and proceed to view our subject.

On the 24th of July, 1865, there assembled at the dental depot of S. S. White, at Chicago, upon a call issued by a committee from the Chicago Dental Society, forty-nine practitioners of dentistry in this State, of whom only eighteen came from outside of that city, for the purpose of organizing a State Society. The objects set forth in the preamble to the Constitution, at that time adopted, were: "To cultivate the science and art of dentistry and collateral branches; to elevate and sustain the professional character of dentists, and to promote among them mutual improvement, social intercourse and good will." It must be remembered that at that time the newspaper name of "tooth carpenter," as applied to our calling, was, perhaps, fully as deserved as that of the "dental profession," and that this declaration of principles was made by men, who, with a very few exceptions, had not had the benefit of being systematically prepared for the pursuit of professional life. In fact, college educated men were conspicuous by their absence, and (perhaps it is no digression to remark here) remained so for many years. It certainly will not be absolutely unfair, if we doubt, somewhat, the entire sincerity of the declaration contained in this preamble, or at least, the sincerity of many of the signers in attaching their names to it; especially so, as we read that Dr. Whetherbee, of Boston was present, soliciting aid to the Boston Protective Union, in their suit to nullify the patent issued to Dr. Cummings, as the inventor of vulcanized rubber base for teeth. It is a fact that the matter of this patent, and the unjust and unreasonable, but yet legal, imposition of the Goodyear Dental Vulcanite Company acted as a common center of attraction and resistance to many dentists. If any were drawn towards this Society by the expected reinforcements in resistance to the exactions of that company to be found at its meetings, or new information in the status of the case they expected to get there, the dental profession of this State has, after all, something to be thankful for, to, and received a benefit from an organization that it was wont to look upon as simply legalized robbers. But be this as it may, the fact nevertheless remains, that if we look back over the nineteen years past the record shows an unvarying faithfulness to the principles laid down as the corner-stone upon which our structure is reared.

Very little was accomplished at the first meeting, except to adopt the Constitution. If any professional subjects were discussed, the record fails to show it.

At the second annual meeting, which was also held in Chicago in May, 1866, a committee was appointed to prepare subjects for discussion, and reported eight different topics, which appear to have been discussed quite generally. A committee was appointed, on motion of Dr. Cushing, to prepare an order of business and a list of subjects for discussion for the next meeting in circular form, and mail the same to all members previously; and to dentists in the State generally, inviting them to attend. This is the beginning of our present systematic method.

Miss Dr. Lucy Hobbs was at this meeting presented to the Society and elected a member, but never qualified; presumably because she soon after joined another society having but one other member, and removed from the State.

The Society met again at Chicago in November, 1866, in semi-annual session. The first address read before this body was prepared and read by Dr. M. S. Dean at this meeting, being written upon invitation of the Society. The record does not tell the subject of the paper. The first clinic was held at this time in the office of Dr. Honsinger. Dr. Cushing opened the first subject for discussion by an essay on "Causes and Prevention of Diseases of the Teeth," being the first essay read before this Society. Discussions on this and other subjects took place. He also gave a clinic at his office. At this session a code of ethics was ordered to be prepared by a committee, who reported substantially the code of the American Dental Association, which was adopted.

The third annual meeting again convened at Chicago in May, 1867. At this session a regular clinic was first established (which has ever since then been maintained at our sessions), and has always been one of the most valued accessories in the work contemplated by this Society. The hours from nine to eleven each morning were set apart for that purpose, but the clinical demonstrations were so interesting that the clinic was prolonged till 2 P. M. The meetings, which had been held semi-annually up to this time, were at this session changed to annual.

Dr. O. Willson read a paper on "Anæsthesia." Drs. Eames, Forbes and Judd of St. Louis, made their debut in the Society at

this session, and were elected honorary members; and no meeting since then has ever been complete without, at least, some of them present, accompanied by others of our brothers from the city across the bridge. At this point it is but justice to observe that these brethren have added no small sum to the value of our debates, in aid of the advancement of our profession. Their efforts have certainly been to our gain, whether to the loss of the Missouri Society or not it is not our province to judge. They heard our Macedonian cry, "come over and help us," and responded. They came willingly to toil in our vineyard; perhaps the soil was easier of cultivation, and promised a richer yield of immediate fruit. St. Louis people, you know, are as proverbial for their laziness as Chicagoans are for their modesty. I presume that accounts for their farming mostly on our side of the river.

A resolution, condemning "the practice of taking students to be sent forth to practice after only from three months to a year's study, and recommending that the term of study should not be less than three years in addition to graduation," was adopted at this session. This resolution, though of itself of no weight or value, especially as the author of it himself never shaped his course by it, is yet the first indications of an endorsement of college education, although only dimly foreshadowed in the word "graduation"

It was, previous to that time, not urged by many of even those who were then considered the better class of practitioners that college training for dentists was particularly desirable, and certainly not essential. Alas, very much to the regret of quite a number of us.

So far as this Society is concerned it was a word of encouragement to colleges, which, later on in the history of this Society, has been iterated and reiterated, and in language of no doubtful meaning, in essays and discussions, and resolutions as well. All this was never done because the colleges then gave us anything in return. Their graduates kept aloof from us for many years. This Society repeatedly emphasized the necessity of collegiate education, but if professors laid any stress upon society membership as essential or desirable to graduates, we failed to see any fruition of such seed sown by them.

Of late years this matter has changed, and the many younger men, who come to our ranks fresh from their studies, have

certainly been a valuable acquisition to us; and I believe that some of that class, who have already risen to a position of national reputation, will tell you that this Society has ripened and broadened and developed their college attained knowledge, and that without this sort of post-graduate exercise they would have remained in a condition very closely allied to stasis if not atrophy.

A new departure was adopted at the session of 1867. It was ascertained that holding the session in Chicago largely constituted a Chicago Society, and perhaps feeling that Chicago, having had three years' training, was ready for graduation—Chicago people being proverbially unselfish—it was decided to adopt the policy of itinerancy in holding our meetings, so as to be in better shape for missionary work in enlightening our professional heathen in the rural districts. This was undoubtedly one of the wisest moves ever adopted under the then existing circumstances, although, with the present condition of the professional status in this state, I believe it may become desirable to alternate between Springfield and Chicago, the capital and commercial metropolis of the State. As the State Board meets at the same time and place as this Society, and the convenience of this Board and their candidates for examination to admission to practice in this State may make such a step judicious at some day.

The fourth annual session was held at Springfield in May, 1868. At this session the Society adopted a seal and blank form of certificate of membership, which was soon discovered to be unwise, and in 1876 the issuance of certificates of membership was discontinued. The reason for this was that the policy of this Society, up to this time, had been to admit every one who practiced dentistry, practically his only pre-requisite and qualification being a good moral character and a willingness on his part to abide by the Constitution and Code of Ethics. This, as a missionary body, was the only course admissible to us, as the object was to improve practitioners, which we could not have done had we insisted on an examination, as we now do, because there was then no compulsion by law, as is now, to be properly qualified before entering upon practice in the State. It was, no doubt, under this system a fact, that men would join this Society to obtain its certificate of membership under gold seal and with colored silk ribbon, which they would have framed, and hang up in their offices, as a sort of diploma and evidence of professional

respectability, and then never come near a meeting again, or pay dues for the support of the Society, unless it should happen to meet in their neighborhood. Under the present system of admission of members it seems to me the issuing of a certificate might be entirely judicious, and certainly not objectionable, as one entering the Society has now first to give satisfactory evidence of his capacity and ability.

At this Springfield session our present method of introducing the subjects for discussion by essays, previously prepared upon them, was first generally introduced.

The fifth annual session convened at Quincy in May, 1869. At this meeting the propriety of printing the report and discussions of the meetings was first suggested, and an arrangement was made with the *Missouri Dental Journal* to publish the same. The essays and discussions were published in full in the July number of that journal for that year.

The sixth annual meeting was held at Bloomington in May, 1870. At this session a paper was read by Dr. Cushing, upon "The propriety of legislation for the protection of the people against dental imposition, etc.;" which was followed by a paper on "Dental Legislation and Plate Work," by Dr. Black. This was the entering wedge which resulted, eleven years later, in the passage of our present State law upon this subject. At this session a committee of three was appointed to draw up a bill regulating the practice of dentistry, and petition to the legislature for its passage. This committee were Dr. Cushing, and Drs. Smith and French of Springfield. The Society voted $25.00 at this session, which was supplemented by personal subscriptions of $120.00 to the testimonial fund to Dr. Barnum, the inventor of the rubber dam. The first Publication Committee was appointed here, and Dr. C. Stoddard Smith, then secretary, had the honor of editing the first one of our annual journals published in the name of this Society.

Our Transactions have, since then, gained year by year, under the accumulated experience of different secretaries, in methods of arrangement and typographical and mechanical beauty and excellence, fully in the ratio that the value of the subject matter of papers and discussions furnished by the members has advanced, until Dr. Noyes brought them to about perfection. But yet, I

must confess that it seems to me that the last volume, issued by our newest secretary, and a very young man, about reaches the extent of possibility of perfectness; and if the members will strive to do their part of this book-making equally as well, it would seem as though ours would certainly be the best of all dental societies, as we believe it now is the best working State Society in the land.

The seventh annual meeting was held at Peoria, in 1871. At this meeting the Committee on Legislation reported that they had made a beginning at the siege of the legislature, and recorded their first repulse; but expressed the hope of securing a capitulation later on. A standing committee on "Infraction of the Code of Ethics" was first appointed at this meeting.

The eighth annual session was held at Chicago, in 1872. At this meeting the Society, for the first and only time in its history, was short for the necessary funds to run its expenses. The annual dues of $2.00 from members not realizing enough to cover the expense incurred by the recently undertaken publication of its Transactions a sufficient amount was at once raised by voluntary contribution. The Committee on Legislation reported that matters were in *statu quo*, and Dr. Black's name was substituted for Dr. C. Stoddard Smith, owing to the latter's absence in Europe.

The session of 1873, the ninth, was held at Rock Island and Davenport, Iowa, in conjunction with the Iowa State Dental Society, and the discussions and papers printed in a volume of joint transactions.

After quite an animated discussion the annual dues were, by amendment to the By-Laws, changed to $4 from $2, and since then the Society has never been embarrassed for funds to do its assumed work, showing the wisdom of the change. An amendment to the By-Laws was also adopted here, making it obligatory upon members not to take students for a less period than three years, and requiring of them "a written obligation to graduate from some regular dental college before assuming the responsibilities of practitioners."

The tenth session convened, in 1874, at Jacksonville. It was here that another repulse by the legislature was reported by the Committee on Legislation, which was now composed of Drs. Cushing, C. S. Smith and Miles. But the committee yet expressed hope of ultimate success, and recommended continuing the siege.

At the eleventh session, held at Ottawa in 1875, another failure in the legislature was reported, and the chairman of the committee came up smiling and said: "It is evident that success can only come from patient and persistent effort;" and so the committee were told they might get ready for the next round.

At the twelfth session at Galesburg, in 1876, the standard of admission to members was raised, by giving the Executive Committee power either to recommend candidates at the meeting at which they apply, or to order the application to lie over for one year, at which time the applicant might be again examined or again laid over, or entirely rejected, as the committee might prefer.

The thirteenth session was held at Springfield, in 1877, during the session of the legislature, and the committee having the dental bill in charge reported only progress, and the Society moved *en masse* on the legislative bulwarks, but was again unsuccessful. At the same session the By-Laws were amended, providing for a Board of Censors, and establishing a standard for an examination of admission to membership, which is substantially the rule governing admission now. Two members were at this session expelled from the Society upon report of its Standing Committee on Infraction of the Code, for violation of the code of ethics.

The fourteenth session was held at Rockford, in 1878.

The fifteenth was held at Springfield, in 1879, and here the Committee on Legislation reported that the bill had passed the Senate, and was likely to pass the House, but it proved again a delusion. Drs. Cushing, Miles and K. B. Davis were continued as the committee.

The sixteenth session was held at Bloomington, in 1880.

The seventeenth was held, in 1881, at Rock Island, where the Legislative Committee again reported a breach effected, and expressed the hope that by a well concerted charge a surrender might be forced from the legislature, which was then in session. Drs. Harlan and Swain were added to the committee, and $150 was voted from the treasury for the use of the committee to aid in defraying their expenses while in the legislative trenches at Springfield, which was supplemented by an appropriation from the Chicago Dental Society. This session adopted a resolution

declaring dentistry a specialty of medicine, and a medical education necessary to the most successful practice of dentistry.

At the eighteenth session, held at Quincy in 1882, we rejoiced at last at the accomplished fact of a law adopted, giving our profession a legal status in the State, and already in full and successful operation, with Dr. Cushing, who for eleven long years led the van of our forlorn hope, as the executive officer of a State Board of Examiners; but we had to mourn a great loss over the death of Dr. Dean, as well.

As this brings our diary down to the personal recollections of all the members, I will now, with your permission, call your attention to a few facts which have come to my notice, in perusing the record of our history. In 1865 we began with 49 members; we have added since then, by election, 193, and restored by reinstatement, 5, making a total membership of 247. Of this number death has taken from us (while members), 4; by removal we have lost 9;. by transfer to honorary list, 1; by resignation, 7, and by non-payment of dues and expelled, 109—a total loss of 130; leaving in good standing at this time, 117. The percentage of those who were dropped for non-payment of dues, in nineteen years, is 44; that of the members now in good standing is a fraction over 47, and scarcely 9 per cent. of our loss was sustained from legitimate causes. The circumstances already referred to will, no doubt, explain this apparently large loss of members for non-payment of dues, as the small amount of the annual tax exacted for the running expenses of this Society could not have been a valid reason for surrendering so beneficial a membership to the members departed. Yet, large as the loss from this cause has been, I doubt if the percentage of 44 in nineteen years is not less than the average experience table of societies generally. That the itinerancy of our Society has been successful in the result sought to be obtained by it, is evidenced by the fact that at the beginning 64 per cent. of its membership was located in Chicago, now 68 per cent. reside outside of that city.

In the first five years of its existence, during seven sessions, only fourteen addresses and essays were read before the Society, or an average of two per session. Since then, in fourteen years and during the period for which our annual Transactions have been

published, 108 addresses and essays have been read, an average of about eight per session. Is there any one so hypercritical as to say it were better that some of these papers had never seen daylight? Perhaps it may be true that many of these productions, measured either from a literary or a scientific standpoint, were of little value: but let it not be forgotten that every effort of this kind compelled some thoughtful consideration; and the stimulus to the exercise of independent thought, and even thought of any kind, that the production of these papers exerted, has not only been of incalculable value to the writers, but to the profession throughout this State; yes, and far beyond its limits as well.

I remarked, some time ago, that Chicago people were proverbially modest, and I imagined I saw a smile pass over the faces of some of this audience. I think, however, that this assertion is capable of verification, so far, at least, as applied to that part of Chicago represented in this body. Look at it! There have been nineteen presidents of this Society, of which, Chicago furnished only seven. Of the nineteen vice-presidents, only four hailed from the city by the lake. Of the nineteen secretaries, *only* fifteen came from Chicago. The Society has been particularly kind to Chicago with the bestowal of this office. But as it is one in which the emoluments are large and the duties and labors merely nominal there never was any demurrer filed. Of the nineteen treasurers, Chicago has only had two. It is evident that the commercial metropolis has not been considered a secure place in which to deposit the shekels of this Society, and our rural friends have generally managed to hold the purse-strings. Whether this was to prevent sudden corners in wheat, or a depleted treasury, they probably know best. Of the nineteen librarians, only three came from Chicago. Upon a whole, it must be said that the honors and burdens have always been fairly divided, and, although there never was any sectional question raised in our elections of officers, the good sense of this body appears by figures, which are said never to prevaricate, to have apportioned things pretty nearly *pro rata*, without especially desiring so to do.

Of the forty-nine original members who organized this Society only six now remain, who have kept up an uninterrupted membership. They are Drs. Cushing, Honsinger and A. W. Freeman of

Chicago; and Drs. Crouse, then of Mt. Carroll; Kitchen, then of Galva; and Ormsbee of Geneva. Drs. Freeman and Housinger have only met with us occasionally and given us their counsels; Drs. Crouse, Kitchen and Ormsbee have been rarely absent from our sessions. Dr. Cushing alone can claim the proud distinction of never having been absent. In this honor he would, however, have had to share with Dr. M. S. Dean, had it not been for his sudden and untimely death. I believe it is but justice to our never-to-be-forgotten departed brother, and not mere meaningless flattery to the living, to say that these two men share alike in the honor of having been the pilots and look-outs who guided our Society ship. The two are indissolubly united, in my mind, and equally so, I am quite sure, in the minds of all the older members of this body, as the men who mapped out the course and largely gave the bearings to whoever was temporarily at the wheel, and always looked out for breakers and shoals ahead. We have, during these years, added many names to our rolls; of men who, through the stimulus obtained at our meetings, have not only become better qualified as dentists, but who have reached a position of fame as students in the science of our specialty, and of the co-related sciences; chiefest of whom is that intrepid knight from Jacksonville, who annually comes to us freighted down with rich nuggets of thought, gathered from the virgin soil of fields previously unexplored; and all of them will admit that a very great share of what they are or have accomplished, is due to this Society and the many words of encouragement and counsel received at the hands of these two men.

An imperial author, in an introduction to his book, asserts that "Historic truth ought to be no less sacred than religion." Reviewing the things accomplished by this Society during the first two decades of its annual sessions, which the present one rounds up, I trust will bring to every one here that encouragement and inspiration to nobler efforts and aspirations, which is ever to be derived from the contemplation of success-crowned endeavor. The record of the earnest labors of the past nineteen years is before us as a matter of history; and certainly the higher altitude, in all things pertaining to professional and scientific life, attained by the dental profession of this State during this brief space of time should be the sacred professional religion of the younger men, who will soon,

under the inevitable laws of time, lead the thought and action of our beneficent profession. The precepts of harmonious and unselfish action, which are revealed to us by the history of this Society, are, I am positive, phenomenal, as compared to the experience of Societies generally, and they are worthy to be made the fundamental principle of the creed that is to guide this body in the future.

Our coming navigators should ever bear in mind that our voyage thus far has been unmarred by the shoals of personal ambition or the breakers of jealousies or clique domination. No storm of internal dissension ever caused a delay in the steady and onward course, nor strained the timbers of our noble young craft. Our young ship, the dental profession, is fast approaching the harbor, where she will moor alongside of her older sisters, heretofore considered of nobler bulk, and she will no longer be looked upon by them as insignificant or an interloper, and an impartial custom house will give her a register as of equal bulk, capacity and staunchness with any other craft. The haven is not far off; already on our course thither we have had many hails of welcome, by cruisers from the thither shore, cheering us on our way. Many of the old officers and crew may not be permitted to see the full completion of the voyage; but thanks to the wisdom, ability, discretion, perseverance and unfaltering and unselfish devotion of such men as our-ever to be revered shipmate Dean, and those to whom he was a shining exemplar and constant companion, whom it would be invidious to mention by name, some of us, like Moses upon Mount Pisgah, have lived long enough to see the promised land, not flowing with milk and honey, but where dentists shall no longer be a lot of mere mechanical "tooth carpenters," as formerly, but where, by reason of deserving it, our craft shall be truly respected and universally recognized as the equals of the other learned professions.

DISCUSSION.

Dr. C. A. KITCHEN of Rockford.

We have listened to an entertaining, as well as a very accurate and concise history of this Society since its organization; and while the writer has brought to our notice much that has been

accomplished through its agency, it would be no easy matter to tell all that has been done or to estimate all the good results in a *direct* and *indirect* way. There is no question unsolved, so there can be no discussion; we all surely agree with the essayist in every statement he has made as to the usefulness and achievements of our Society. Those who have been longest connected with it and who have been most regular in attendance at its sessions, best know and feel its inspiring influence, and are the best able to compare its present condition with the past.

I have thought, while coming into this magnificent building from day to day, that our Society might be compared to it in many respects. In the first place, both are State institutions, whose foundations were laid broad and deep, many years ago, to support grand superstructures. Then this building has many strong pillars and columns upon which its endurance depends. Our Society has its pillar men; columns of strength they are, and firm as adamant in their devotion to this Society; and they will continue to uphold and support the structure they have erected. All about us are to be seen beautiful ornaments, proving that the hand of the artist and the master-workman have contributed in these adornments. We have members, earnest students, tireless investigators, who bring us each year the rich fruits of their researches. They are our ornaments; their works are admired and esteemed throughout the whole country, and by the profession everywhere. This building has reached, in its construction, a stage of usefulness where it answers the main purpose for which it was intended, though not yet completed. Our Society has accomplished, and is accomplishing, a great work. It has arrived at a stage of usefulness, but its power and influence are only *beginning* to be felt. A larger work is yet before it.

The State House has been brought to its present condition by vast appropriations, and a large outlay must yet be made to carry it forward to completion and to keep it in order. This Society has reached its present state of excellence through the appropriations of valuable time and thought; and the members will still be called upon to contribute largely for its future support and increasing demands. Many, perhaps all, who have been making these appropriations from year to year have themselves been compensated in return; but *some*, whose names were mentioned in the paper, can scarcely realize how

much they *have* done towards placing and keeping this Society up to a standard of excellence. Through their influence and example the members have learned to love and honor the profession and to uphold professional dignity and deportment.

A courteous greeting and hearty encouragement have been given to all who have joined our ranks from proper motives, and they have been content to remain with us; but a few, who could not find an opportunity to gratify selfish ambition, have soon found it an uncomfortable abiding place, and have left vacancies which were speedily filled by more worthy men. We might spend hours profitably in dwelling upon thoughts suggested by the paper and in reviewing our past history, but the hour of adjournment approaches, and time does not permit. We have this assurance, judging by its past activity, and by the spirit of enterprise and progress engendered by the long years of fellowship and associated labor, that this Society will go forward to still greater achievements, and will, in the future, fulfill the highest hopes of its founders and friends.

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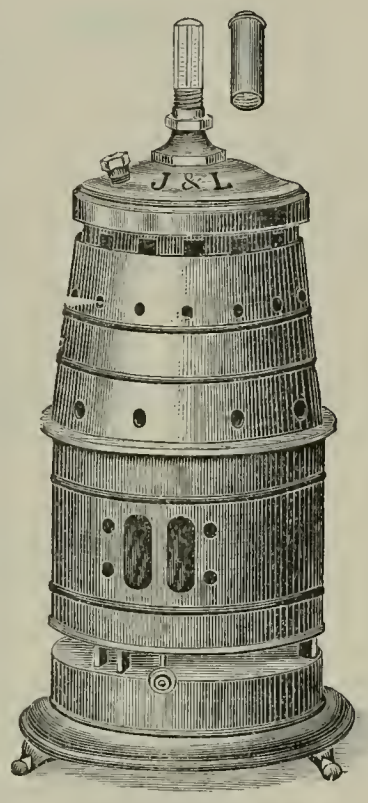

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Johnson & Lund's Improved Vulcanizers are furnished with thermometer, mercury bath, one packing in place and an extra piece, extra disks for the safety-valve, requisite number of wrenches, malleable iron or brass flasks at option of purchaser. When no flasks are mentioned the brass ones will always be sent with the apparatus. We especially call attention to the flasks furnished with these Vulcanizers. They are of the pattern known as the **ANCHOR FLASKS.** Owing to their peculiar formation, an extra amount of room is afforded for the case to be vulcanized, and the bolts can be detached and replaced with great facility, without removing the screw from the nut.

PRICES.

Two-Case Vulcanizer, copper boiler, furnished with thermometer, packing, jacket, lamp, disks for safety-valve, two flasks (either malleable iron or brass, at the option of the purchaser), and wrenches—complete for alcohol $14 00
Ditto—complete for gas 14 00
Ditto—with No. 1 Union Kerosene Stove, in place of gas or alcohol burners—complete for kerosene 15 00
Three-Case Vulcanizer, copper boiler, furnished with thermometer, packing, jacket, lamp, disks for safety-valve, three flasks (either malleable iron or brass, at the option of the purchaser), and wrenches—complete for alcohol 15 00
Ditto—complete for gas 15 00
Ditto—with No. 1 Union Kerosene Stove, in place of gas or alcohol burners—complete for kerosene 16 00

NOTE.—We make no allowance where Vulcanizers with malleable iron flasks are ordered instead of brass ones.

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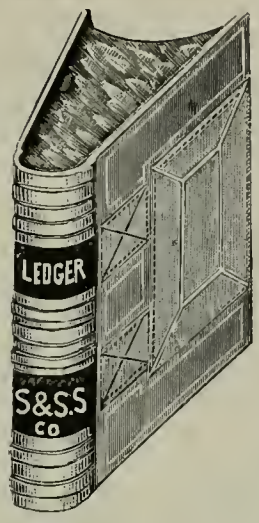

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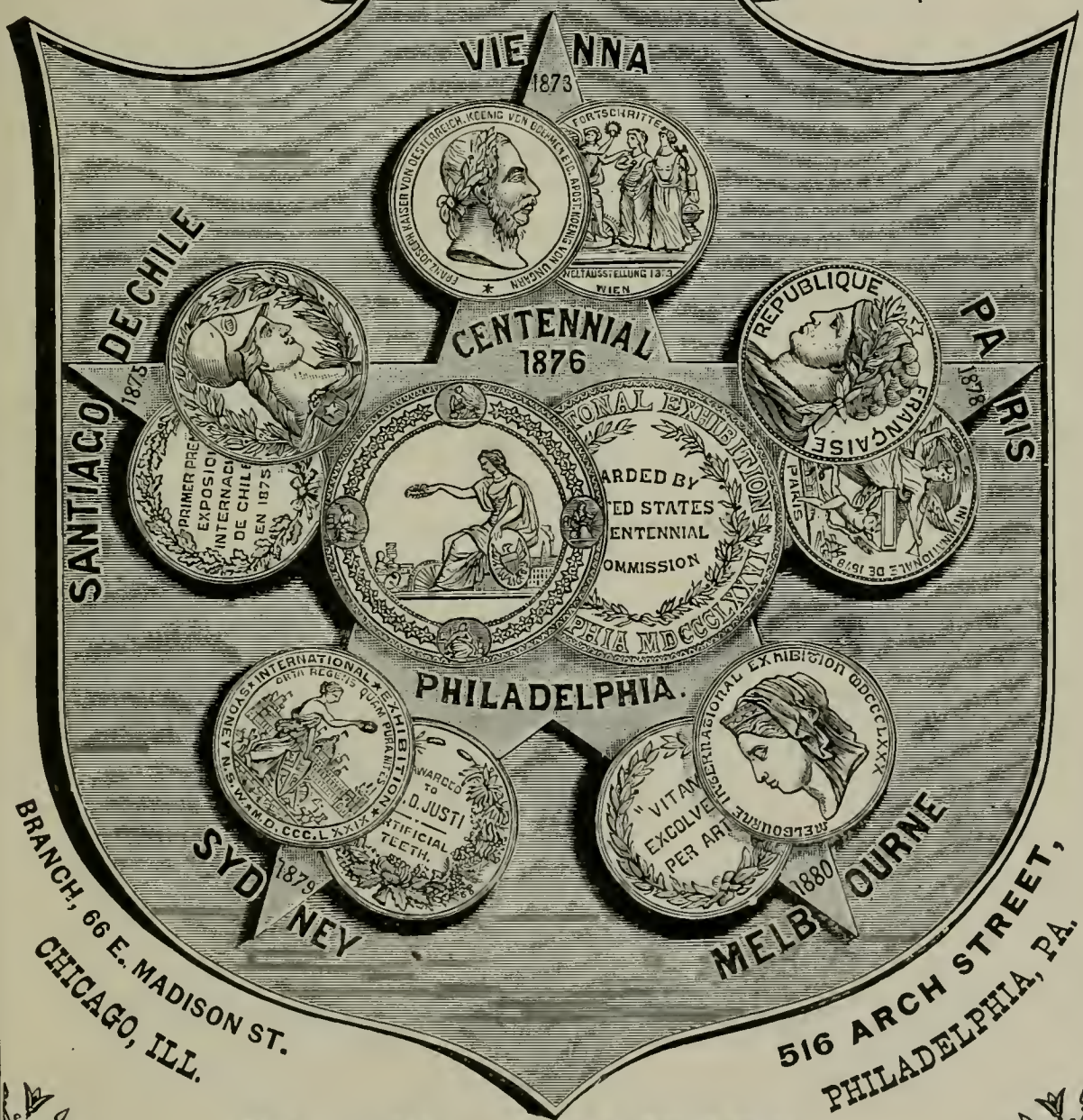

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In the meantime, it remains to be seen how far respectable publishing houses will allow themselves to be imposed on; and how far dental societies will allow their published transactions to be prostituted to private interests without rebuke. *Consult the Illinois State Dental Society Transactions of 1884, pages 127 to 146.*

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